Project 1: Predicting Catalog Demand

Complete each section. When you are ready, save your file as a PDF document and submit it here: https://classroom.udacity.com/nanodegrees/nd008/parts/c0b53068-1239-4f01-82bf-24886872f48e/project

Step 1: Business and Data Understanding

Provide an explanation of the key decisions that need to be made. (500 word limit)

Key Decisions:

Answer these questions

1. What decisions needs to be made? In this project I need to predict the sales for a 250 new customers that compose a mailing list. The idea here is to predict if the sum of these future sales will be beyond the $10,000 mark, and otherwise, no mailing actions will be performed by the company.

2. What data is needed to inform those decisions? I will need historical data regarding customers from the company and their associated sales number (training set), such as the information about the new customers (test set). The data must include the average profit we make for each catalogue we send to a customer and the costs to do so, including printing and distribution values. I will also work on data that determines if customers have bought items from the catalogue in the past, the average number of items each customer bought from the company and the average customer expenses when previously ordering from the past catalogues.

Step 2: Analysis, Modeling, and Validation

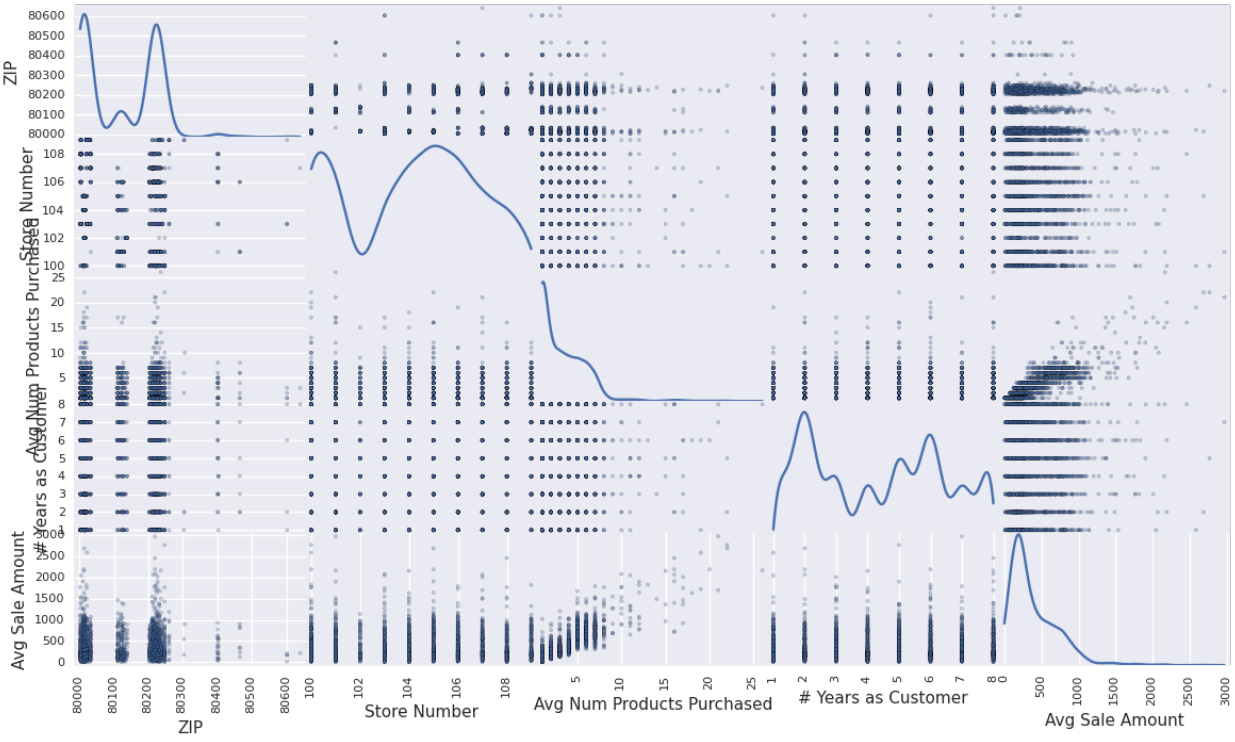
Provide a description of how you set up your linear regression model, what variables you used and why, and the results of the model. Visualizations are encouraged. (500 word limit)

Important: Use the p1-customers.xlsx to train your linear model.

At the minimum, answer these questions:

1. How and why did you select the predictor variables (see supplementary text) in your model? You must explain how your continuous predictor variables you've chosen have a linear relationship with the target variable. Please refer to this lesson to help you explore your data and use scatterplots to search for linear relationships. You must include scatterplots in your answer. I've used Pandas (see the Jupyter notebook in this repo) to work on this project, and before anything, I've removed the customer segment variable (as stated in a note below). I then used pandas to plot the scatter matrix to each the

linear correlation amongst each pair of variables. The following plot shows this matrix. I can't see any obvious correlations from these plots, but there seems to be some kind of correlation between 'Avg Num Products Purchased' and 'Avg Sale Amount' (which is somehow expected, since if you purchase more products the same amount is also expected to increase). To be sure I wasn't missing anything, I also plotted a heatmap with the correlations between each pair of attributes, which is also presented below. On the heatmap, we can confirm this correlation between these two features, which has a pearson correlation of 0.855754 to be precise. A possible question here would be why the correlation doesn't seem so clear in the scatter matrix, and my argument is that we have many outliers that don't allow us to clearly see the "dense" part of the plot (lower left) which has a lot of data. Given that, I will try to learn a model using the ZIP, Store Number, Avg Num Products Purchased and #Years as Customer to predict the Avg Sale Amount for each customer. After that, I computed the p-values for each of the variables, and removed the baseline for the dummies: ['Customer Segment']_Loyalty Club Only.



2. Explain why you believe your linear model is a good model. You must justify your reasoning using the statistical results that your regression model created. For each variable you selected, please justify how each variable is a good fit for your model by using the p-values and R-squared values that your model produced. If we analyze the R squared result obtained by my linear regression model, we'll see that it resulted in a value of 0.8317, which depicts a relatively high determination coefficient. In the next question I present the regression equation, which uses only attributes with a p-value below 0.05. The p-value for each variable that I originally had in my dataset is:
    - ZIP has a p-value of 0.697757997163
    - Store Number has a p-value of 0.698733999956
    - Avg Num Products Purchased has a p-value of 0.0
    - # Years as Customer has a p-value of 0.146794828448
    - ['Customer Segment']_Credit Card Only has a p-value of 1.59755756527e-105
    - ['Customer Segment']_Loyalty Club and Credit Card has a p-value of 3.76987503221e-224
    - ['Customer Segment']_Store Mailing List has a p-value of 3.33692101866e-305
    - Attributes with p-value > 0.05 = ['ZIP', 'Store Number', '# Years as Customer']

3. What is the best linear regression equation based on the available data? Each coefficient should have no more than 2 digits after the decimal (ex: 1.28)
   Y = 66.98 * Avg Num Products Purchased + 149.36 * ['Customer Segment']_Credit Card Only + 431.19 * ['Customer Segment']_Loyalty Club and Credit Card + -96.06 * ['Customer Segment']_Store Mailing List + 0 * ['Customer Segment']_Loyalty Club Only + 154.11

Note: For students using software other than Alteryx, if you decide to use Customer Segment as one of your predictor variables, please set the base case to Credit Card Only.

Step 3: Presentation/Visualization

Use your model results to provide a recommendation. (500 word limit)

At the minimum, answer these questions:

1. What is your recommendation? Should the company send the catalog to these 250 customers? Yes, given my computations, the profit would be above the threshold that the manager has set, which was of USD 10,000. (see following answers)

2. How did you come up with your recommendation? (Please explain your process so reviewers can give you feedback on your process) I learned a linear regression model from historical sales to predict the values of sales for 250 future customers and the sum of these values was then converted into a gross margin (of 50%), which resulted in a value of USD 69146.07. By multiplying the 'Score_Yes' to the customers predicted values, we achieve our expected revenue of USD 23612.44. Evidently, there is a cost to print and distribute all the 250 catalogs, which is 250 * 6.50 = USD 1625.00, which should be then decreased from the revenue.
3. What is the expected profit from the new catalog (assuming the catalog is sent to these 250 customers)? Given the latter process, if we take the revenue (USD 23612.44) and decrease the printing and distribution costs (USD 1625.00), the profit would be of USD 21987.44, which is above the threshold set by the manager (USD 10,000), and thus, my recommendation would be of printing and distributing the catalog.

Before you Submit

Please check your answers against the requirements of the project dictated by the rubric here. Reviewers will use this rubric to grade your project.