

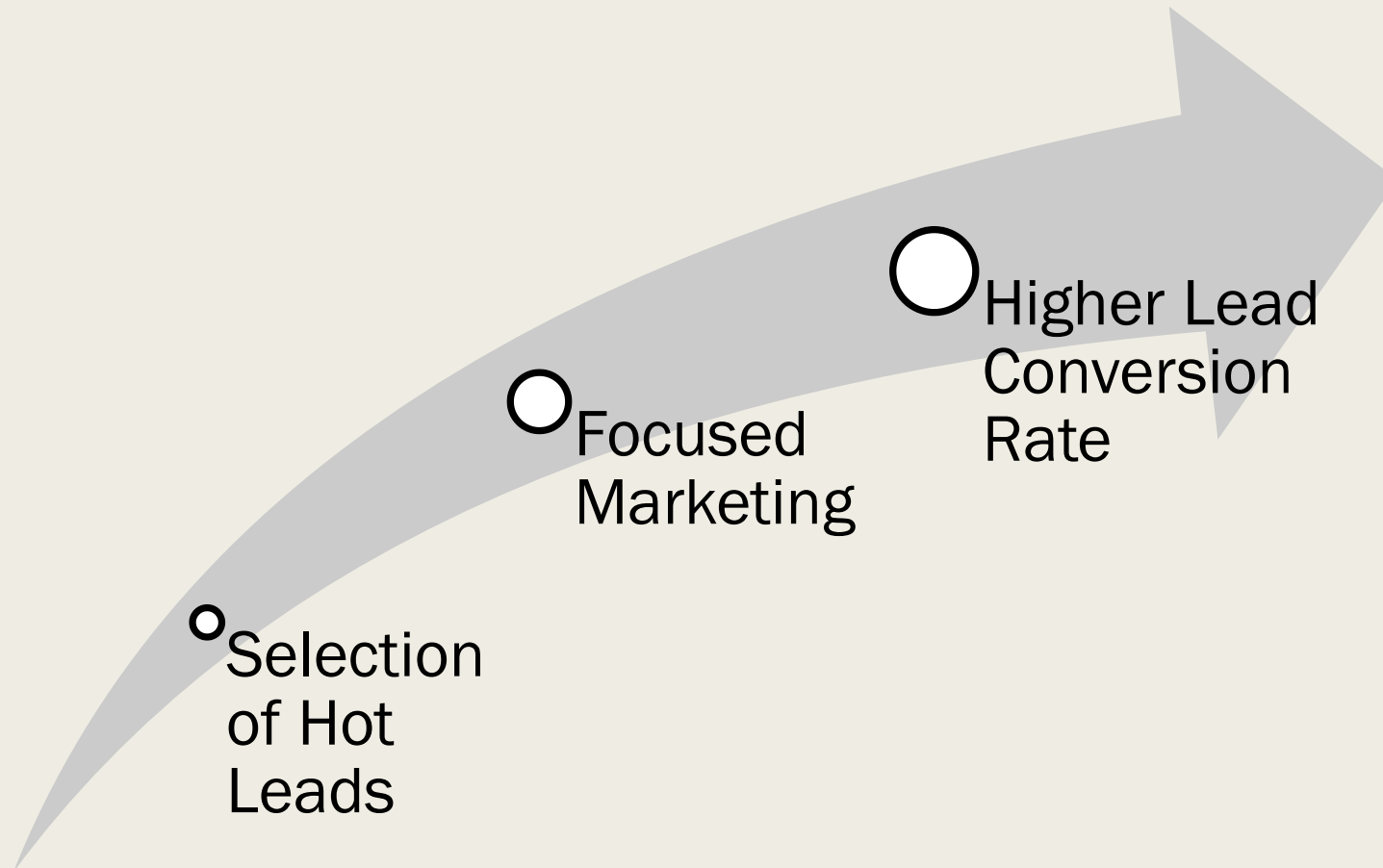
LEAD SCORING CASE STUDY

Focused business approach using logistic regression technique

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Business Objective

To help X Education select most promising leads (*Hot Leads*), i.e. the leads that are most likely to convert into paying customers.

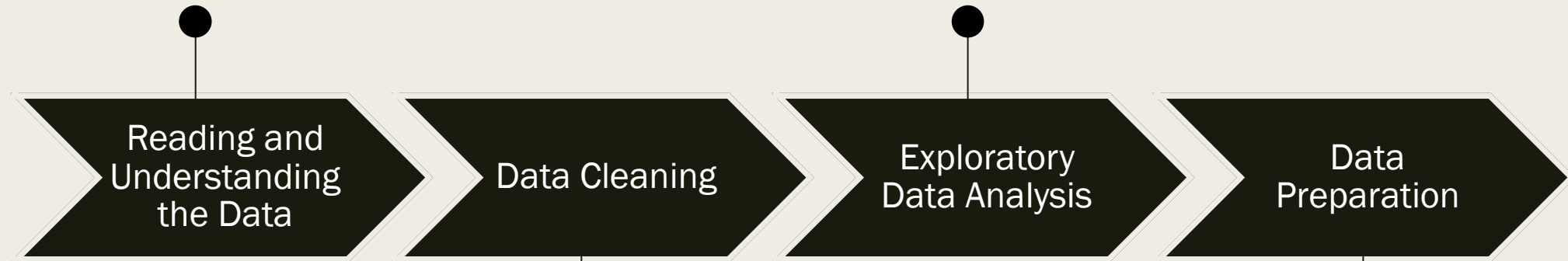


METHODOLOGY

To build a Logistic Regression model that assigns lead scores to all leads such that the customers with higher lead score have a higher conversion chance and vice versa.

Target Lead Conversion Rate \approx 80%

Importing and Observing
the past data provided by
the Company



Reading and
Understanding
the Data

Data Cleaning

Exploratory
Data Analysis

Data
Preparation

- Missing value imputation
- Removing duplicate data and other redundancies

- Outlier treatment
- Dropping unnecessary columns
- Dummy variable creation
- Feature standardization

- Feature selection using RFE
- Manual feature elimination based on p-values and VIFs



- Building another model using PCA
- Comparing the two models

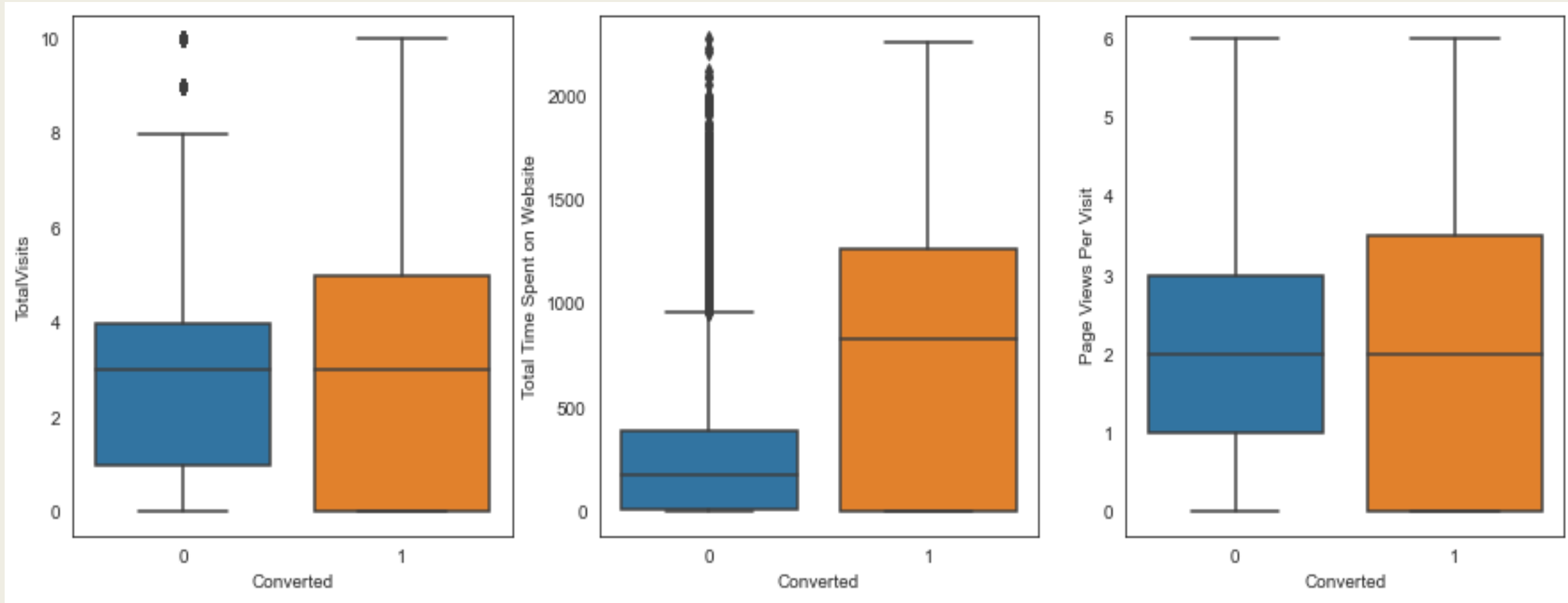
- Evaluating model based on various evaluation metrics
- Finding the optimal probability threshold

- Finalizing the first model
- Using predicted probabilities to calculate Lead Scores:
Lead Score = Probability * 100

DATA VISUALIZATION

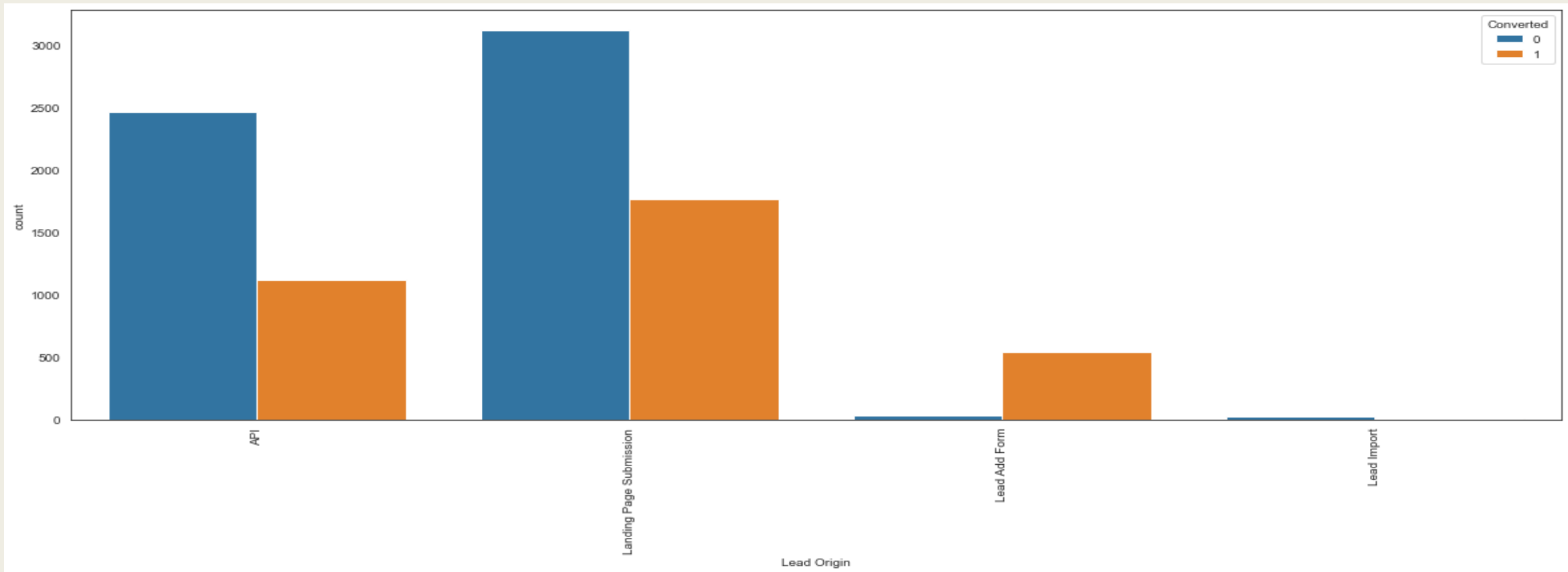
- To identify important features
 - To get insights

Numerical Variables



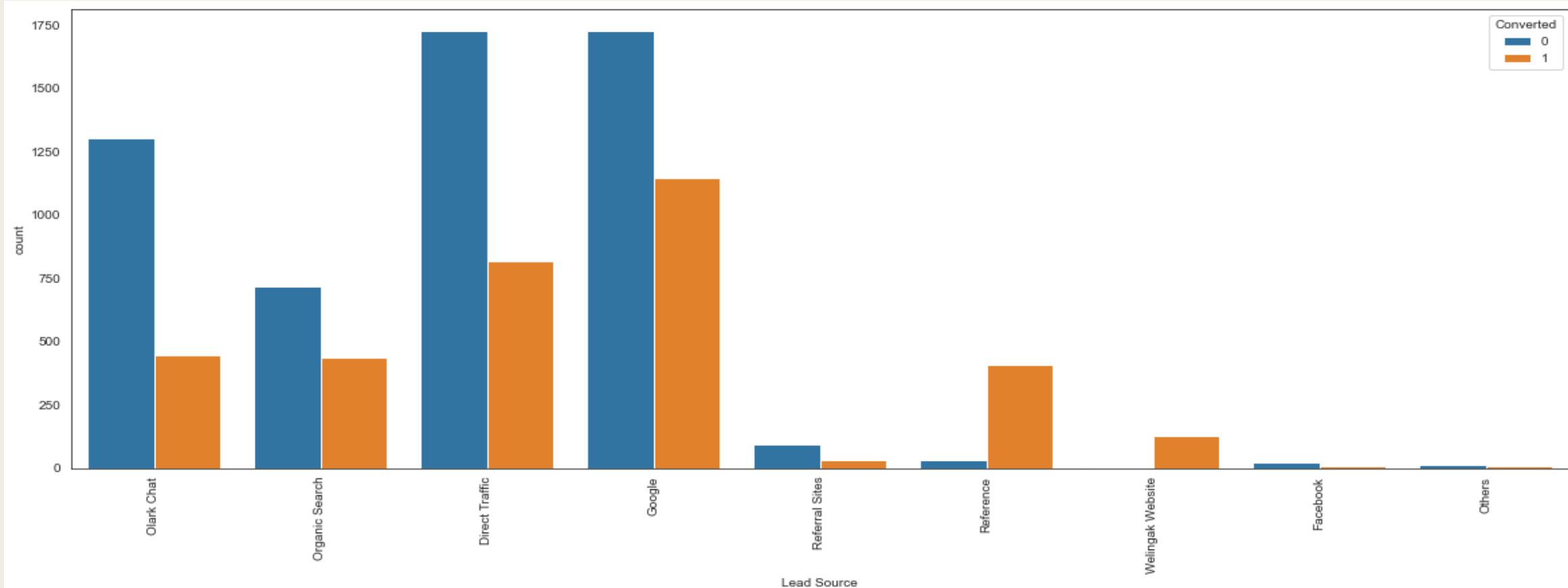
People spending more time on website are more likely to get converted.

Lead Origin



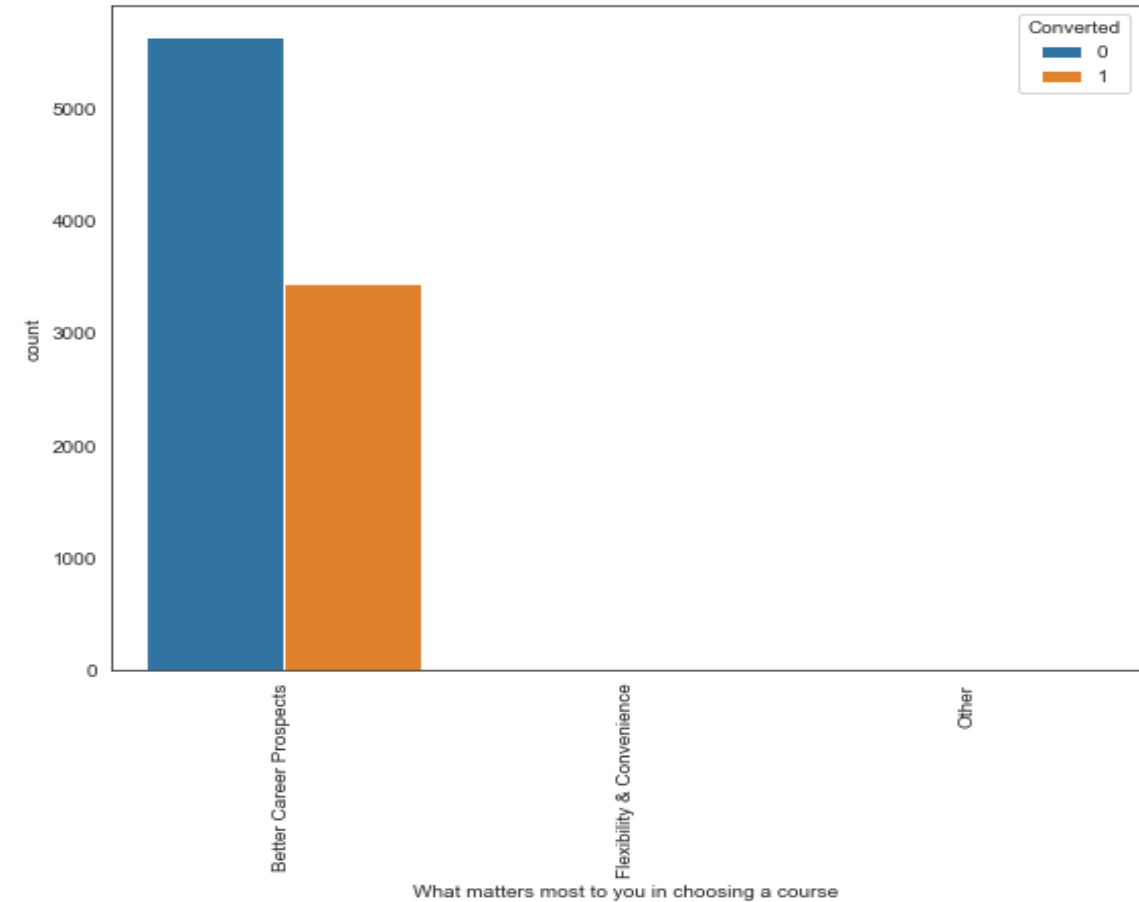
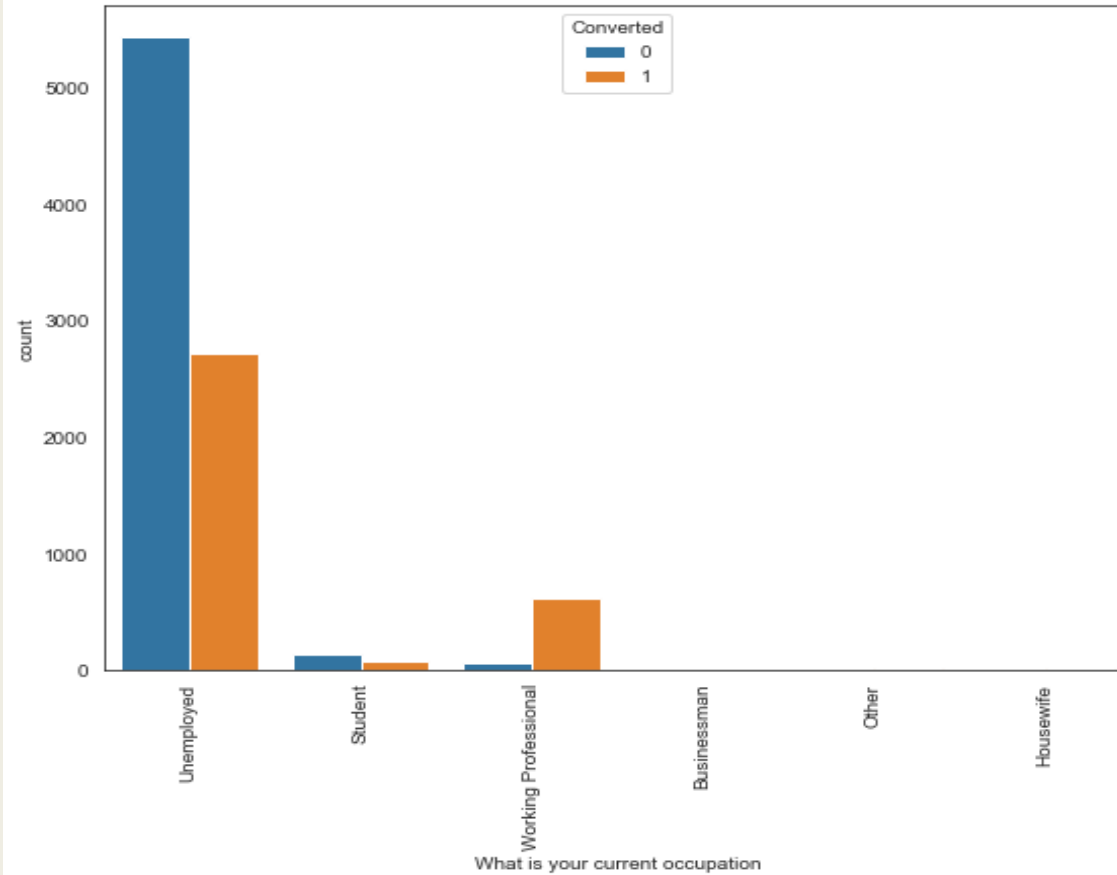
- ***'API'*** and ***'Landing Page Submission'*** generate the most leads but have less conversion rates, whereas ***'Lead Add Form'*** generates less leads but conversion rate is great.
- Try to increase conversion rate for ***'API'*** and ***'Landing Page Submission'***, and increase leads generation using ***'Lead Add Form'***.

Lead Source



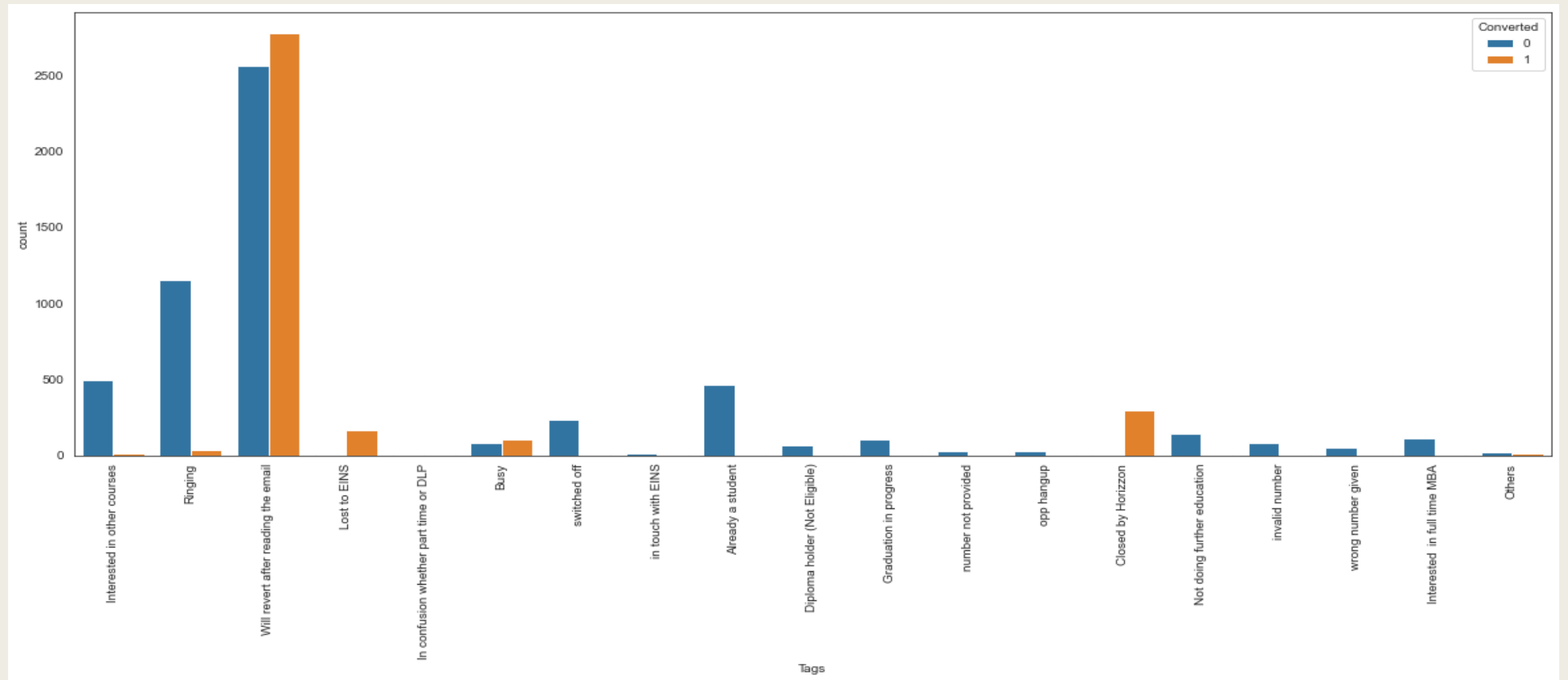
- Very high conversion rates for lead sources '**Reference**' and '**Welingak Website**'.
- Most leads are generated through '**Direct Traffic**' and '**Google**'.

Current Occupation



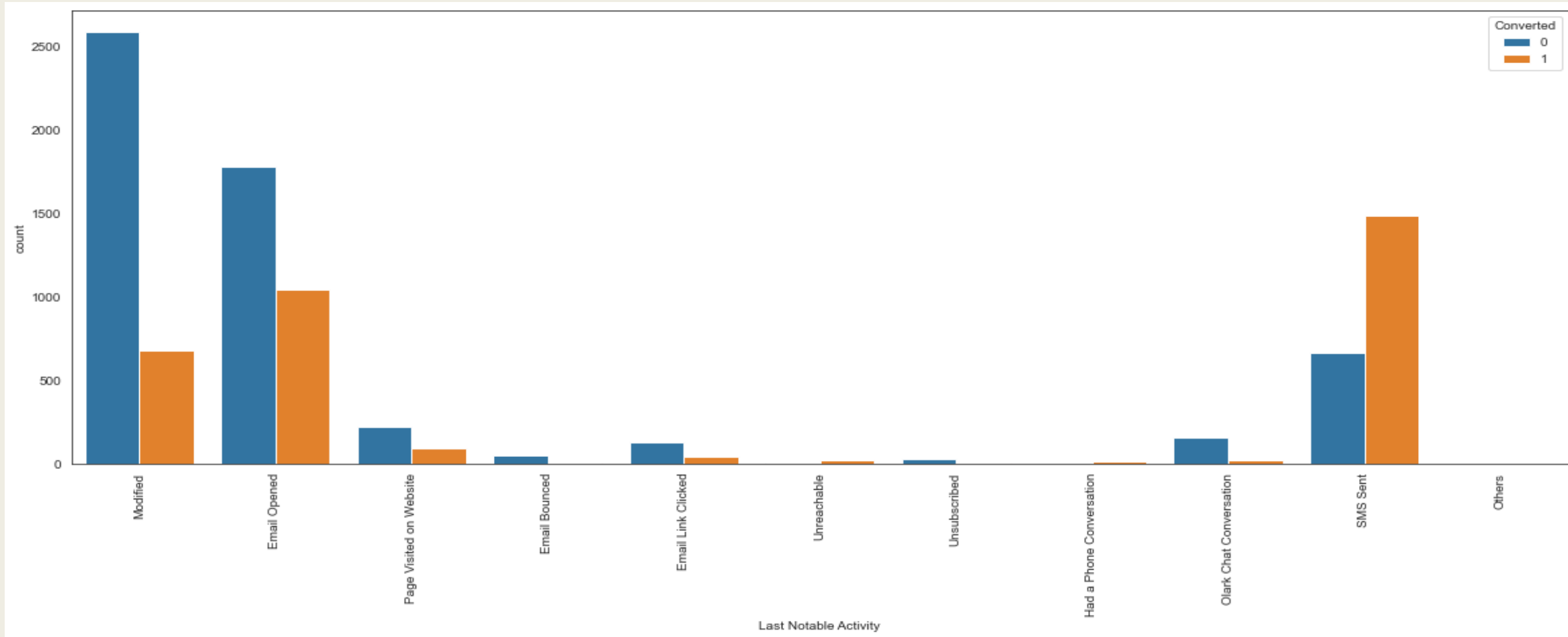
Working Professionals are most likely to get converted.

Tags



High conversion rates for tags 'Will revert after reading the email', 'Closed by Horizon', 'Lost to EINS', and 'Busy'.

Last Notable Activity



Highest conversion rate is for the last notable activity '**SMS Sent**'.

MODEL EVALUATION



Generalized Linear Model Regression Results

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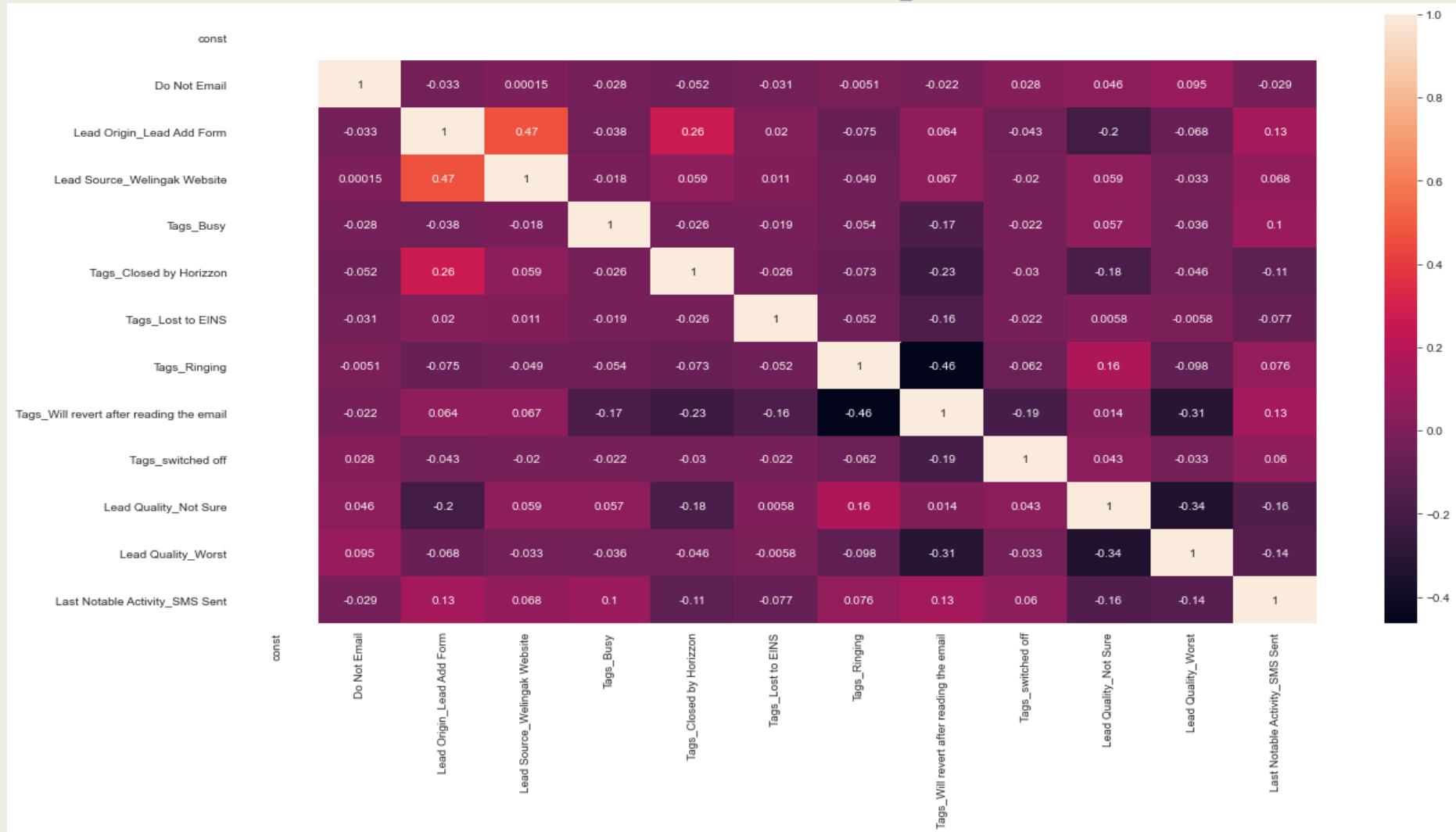
=====
Dep. Variable:          Converted    No. Observations:          6351
Model:                  GLM         Df Residuals:              6338
Model Family:           Binomial    Df Model:                  12
Link Function:           logit      Scale:                     1.0000
Method:                 IRLS        Log-Likelihood:           -1601.0
Date:                   Mon, 18 May 2020    Deviance:                 3202.0
Time:                   02:23:54    Pearson chi2:             3.48e+04
No. Iterations:         8
Covariance Type:        nonrobust
=====

```

	coef	std err	z	P> z	[0.025	0.975]
const	-1.9192	0.211	-9.080	0.000	-2.333	-1.505
Do Not Email	-1.2835	0.212	-6.062	0.000	-1.698	-0.868
Lead Origin_Lead Add Form	1.2035	0.368	3.267	0.001	0.482	1.925
Lead Source_Welingak Website	3.2825	0.820	4.002	0.000	1.675	4.890
Tags_Busy	3.8043	0.330	11.525	0.000	3.157	4.451
Tags_Closed by Horizzon	7.9789	0.762	10.467	0.000	6.485	9.473
Tags_Lost to EINS	9.1948	0.753	12.209	0.000	7.719	10.671
Tags_Ringing	-1.8121	0.336	-5.401	0.000	-2.470	-1.154
Tags_Will revert after reading the email	3.9906	0.228	17.508	0.000	3.544	4.437
Tags_switched off	-2.4456	0.586	-4.171	0.000	-3.595	-1.297
Lead Quality_Not Sure	-3.5218	0.126	-28.036	0.000	-3.768	-3.276
Lead Quality_Worst	-3.9106	0.856	-4.567	0.000	-5.589	-2.232
Last Notable Activity_SMS Sent	2.7395	0.120	22.907	0.000	2.505	2.974

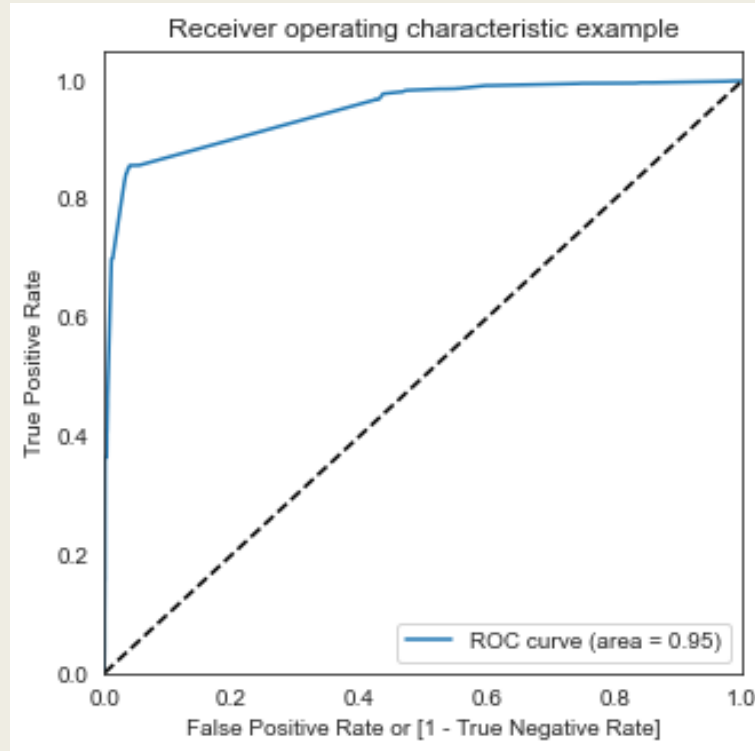
Final Model Summary: All p-values are zero.

Heatmap



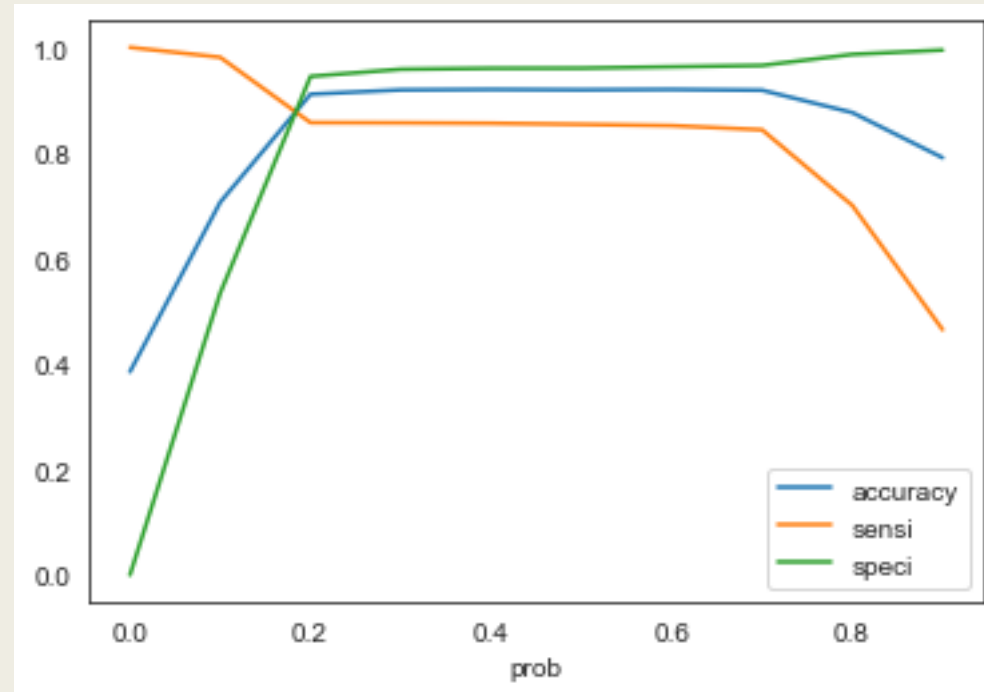
Correlations between features in the final model are negligible.

ROC curve



Area under curve = 0.95

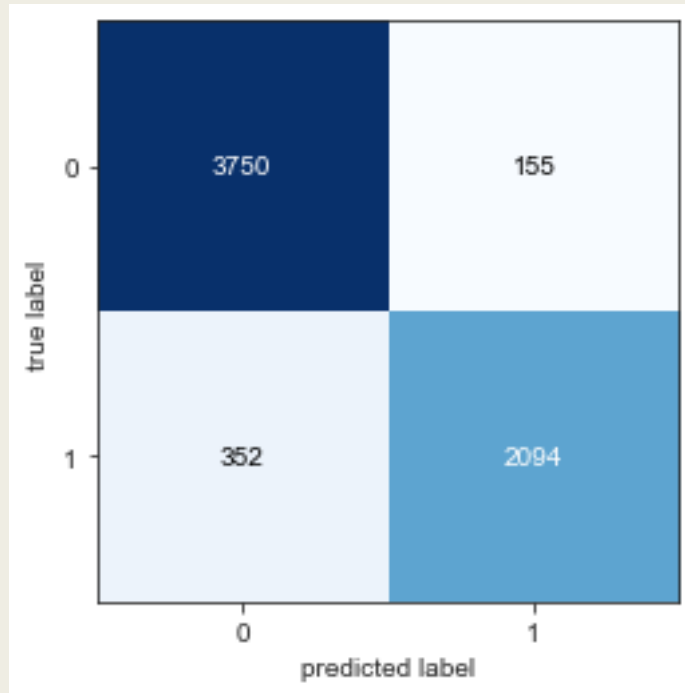
Finding Optimal Threshold



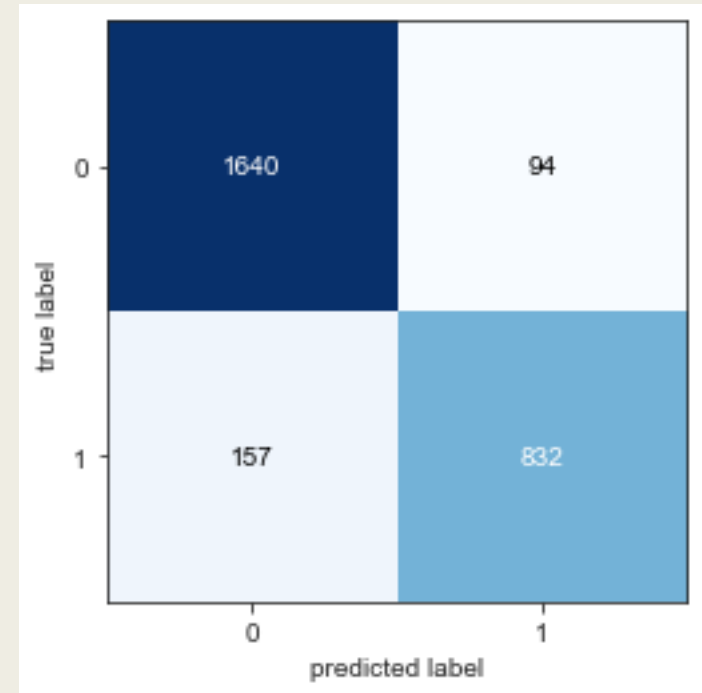
Graph showing changes in Sensitivity, Specificity and Accuracy with changes in the probability threshold values

Optimal cutoff = 0.20

Confusion Matrix



For train set

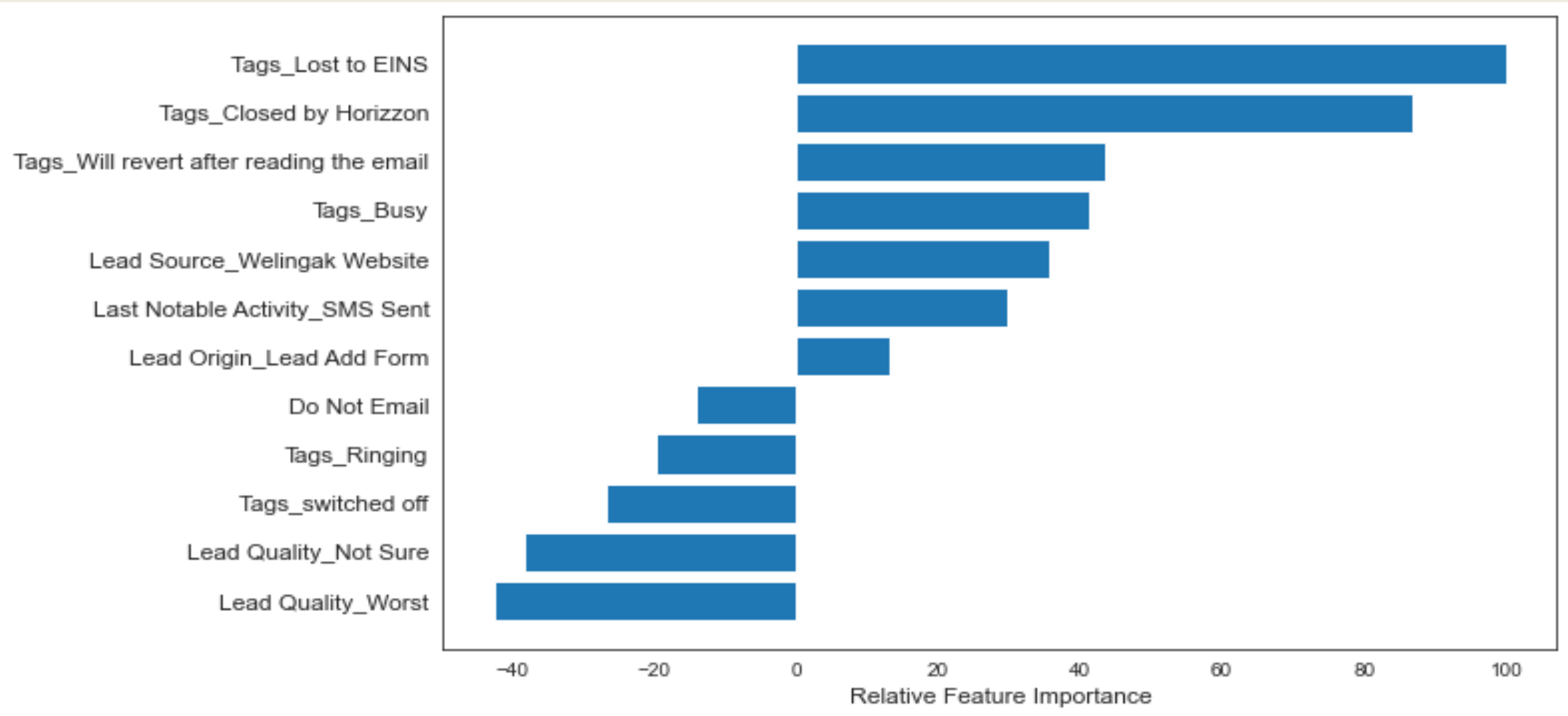


For test set

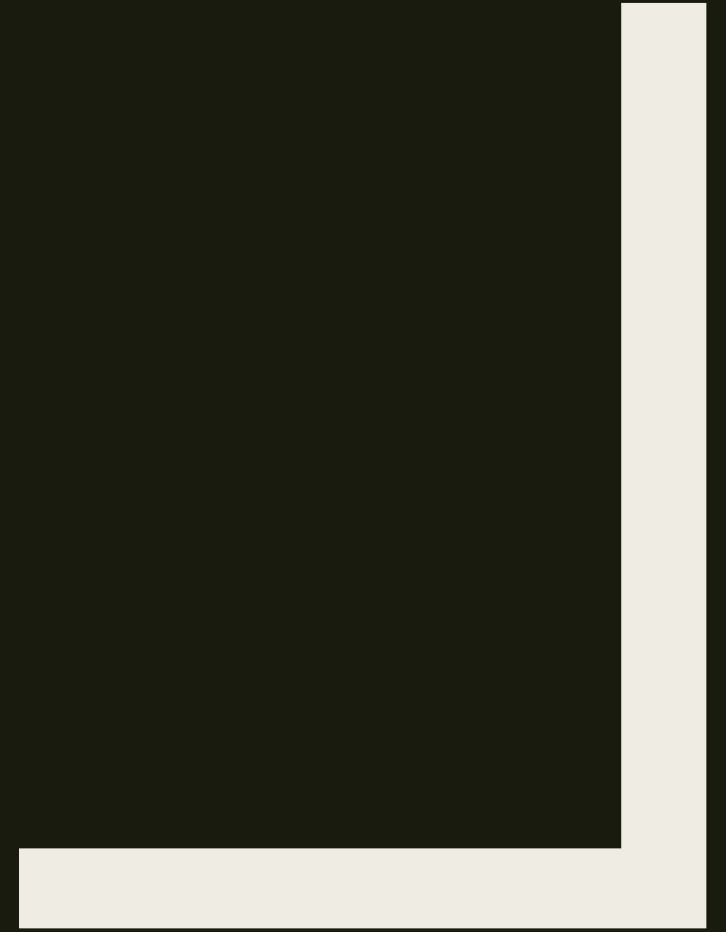
Final Results

Data	Train set	Test set
Accuracy	0.9111	0.9078
Sensitivity	0.8573	0.8412
Specificity	0.9449	0.9457
False Positive Rate	0.0550	0.0542
Positive Predictive Value	0.9070	0.8984
Negative Predictive Value	0.9135	0.9126
AUC	0.9488	0.9388

Relative Importance Of Features



INFERENCES



Feature Importance

- Three variables which contribute most towards the probability of a lead conversion in decreasing order of impact are:

I. Tags_Lost to EINS

II. Tags_Closed by Horizzon

III. Tags_Will revert after reading the email

- These are dummy features created from the categorical variable Tags.
- All three **contribute positively** towards the probability of a lead conversion.
- These results indicate that the company should **focus more on the leads with these three tags.**

Situation 1: Company has interns for 2 months. They wish to make lead conversion more aggressive. They want almost all of the potential leads to be converted and hence, want to make phone calls to as much of such people as possible.

Solution:

- ***Sensitivity = True Positives / (True Positives + False Negatives)***
- Sensitivity can be defined as the number of actual conversions predicted correctly out of total number of actual conversions. As we saw earlier, sensitivity decreases as the threshold increases.
- High sensitivity implies that our model will correctly predict almost all leads who are likely to convert. At the same time, it may overestimate and misclassify some of the non-conversions as conversions.
- As the company has extra man-power for two months and wants to make the lead conversion more aggressive, it is a good strategy to go for **high sensitivity**. To achieve high sensitivity, we need to **choose a low threshold value**.

Situation 2: At times, the company reaches its target for a quarter before the deadline. It wants the sales team to focus on some new work. So during this time, the company's aim is to not make phone calls unless it's extremely necessary.

Solution:

- ***Specificity = True Negatives / (True Negatives + False Positives)***
- Specificity can be defined as the number of actual non-conversions predicted correctly out of total number of actual non-conversions. It increases as the threshold increases.
- High specificity implies that our model will correctly predict almost all leads who are not likely to convert. At the same time, it may misclassify some of the conversions as non-conversions.
- As the company has already reached its target for a quarter and doesn't want to make unnecessary phone calls, it is a good strategy to go for **high specificity**.
- It will ensure that the phone calls are only made to customers who have a very high probability of conversion. To achieve high specificity, we need to **choose a high threshold value**.

Recommendations

- By referring to the data visualizations, focus on
 - *Increasing the conversion rates for the categories generating more leads and*
 - *Generating more leads for categories having high conversion rates.*
- Pay attention to the relative importance of the features in the model and their positive or negative impact on the probability of conversion.
- Based on varying business needs, modify the probability threshold value for identifying potential leads.

THANK YOU

