Lead Scoring Case Study

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Problem Statement

X Education, an online course provider, aims to improve its lead conversion process by identifying high-potential leads and enhancing sales efficiency.

1. **Low Lead Conversion Rate**: X Education's current lead conversion rate is approximately 30%, meaning only 30 out of 100 leads convert into paying customers. The company wants to improve this efficiency.
2. **Identifying Potential Leads (Hot Leads)**: The company seeks to build a logistic regression model that can assign a lead score (0-100) to identify leads most likely to convert. This would help the sales team focus on high-potential leads.
3. **Target Conversion Rate:** The CEO expects the model to help achieve a target lead conversion rate of 80%, by better prioritizing lead engagement and communication.
4. **Lead Nurturing for Higher Conversion**: The lead conversion process requires nurturing potential leads (e.g., educating them about the product and maintaining consistent communication) to increase conversion rates through the sales funnel.

Business Objective

Improve Lead Conversion Efficiency: Increase the lead conversion rate from the current **30%** by identifying and prioritizing high-potential leads (Hot Leads).

Develop a Scoring System: Build a logistic regression model to assign a lead score (0-100) that reflects the likelihood of a lead converting into a paying customer.

Optimize Sales Efforts: Enable the sales team to focus on high-potential leads by improving the lead nurturing process, leading to better communication and higher conversions.

Data Overview

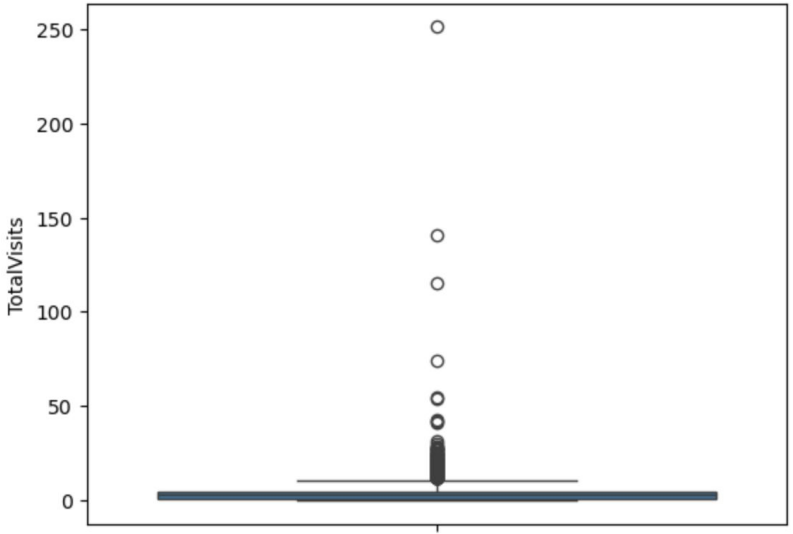
- **Dataset**: ~9,000 leads with multiple features:
  - Lead Source, Time Spent on Website, Total Visits, Last Activity, etc.
- **Target Variable**: Converted (1 = Converted, 0 = Not Converted).
- **Challenges**:
  - Missing values in attributes.
  - 'Select' in categorical variables (treated as null).
- To be cleaned and prepared for modeling.

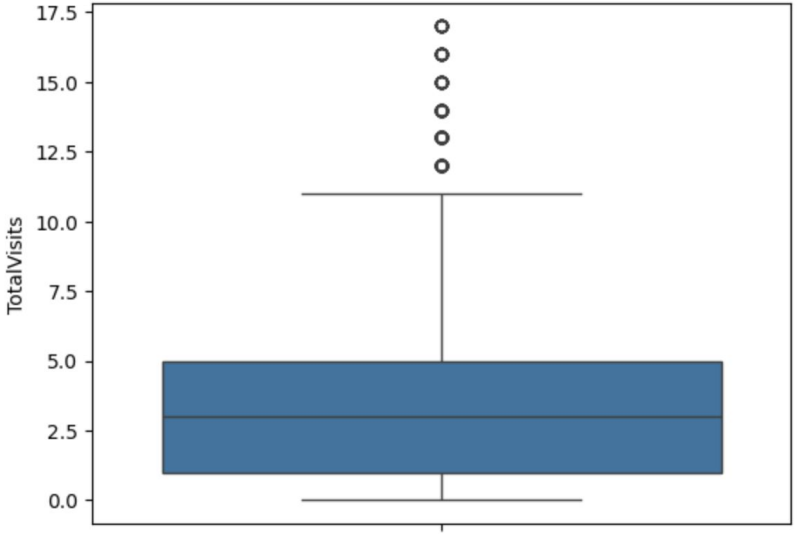
Data Cleanup

- ‘Prospect ID’ column is dropped since ‘Lead Number’ is our unique identifier.
- Dropped columns where missing values are more than 40%.
- Certain columns have ‘Select’ values which are changed to ‘Unknown’ and are handled as missing values.
- Dropped columns again where the count of ‘Unknown’ values are more than 40% since it is considered as missing values.

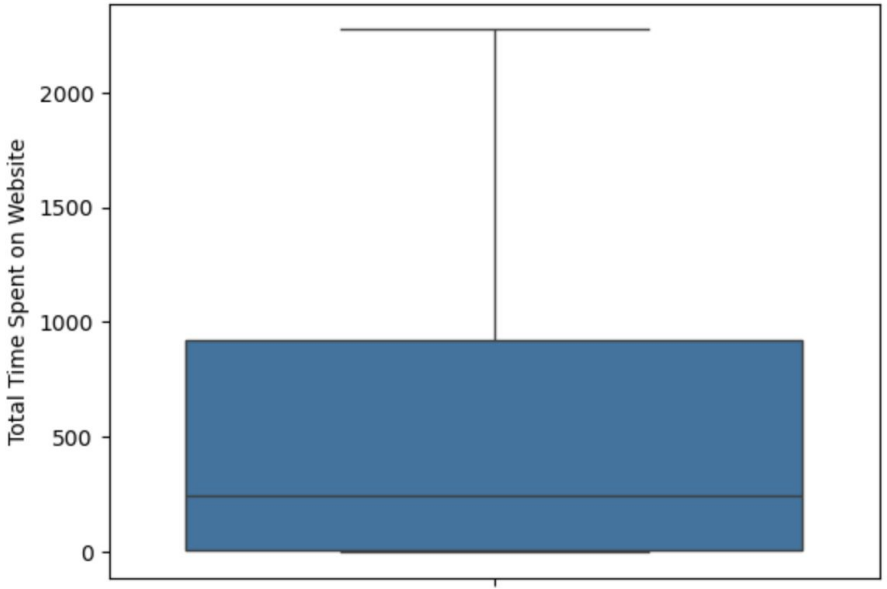
Data Preparation - Outliers handling

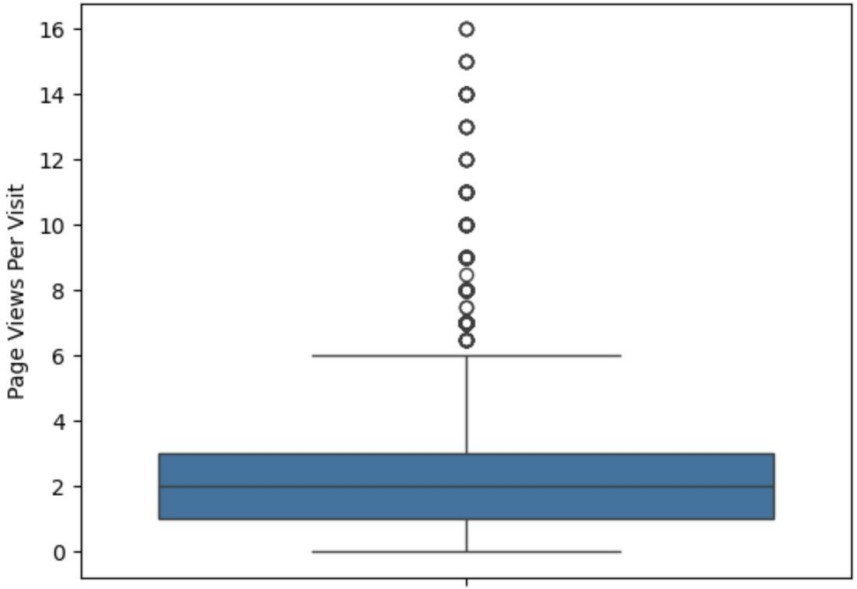
- ‘TotalVisits’ variable had some outliers. These were removed able above the 99 percentile.





Outliers Handling

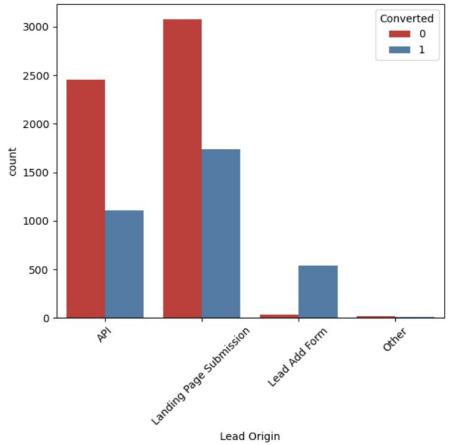


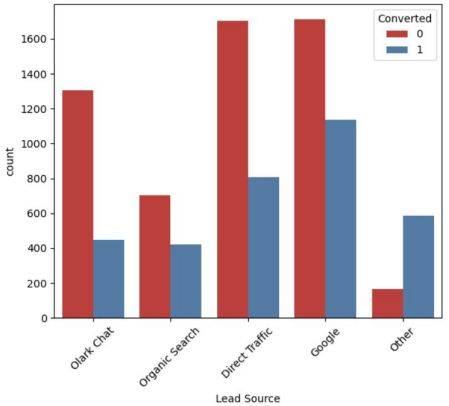


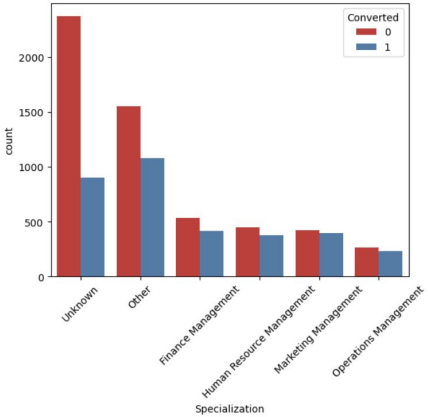
Categorical variables preparation

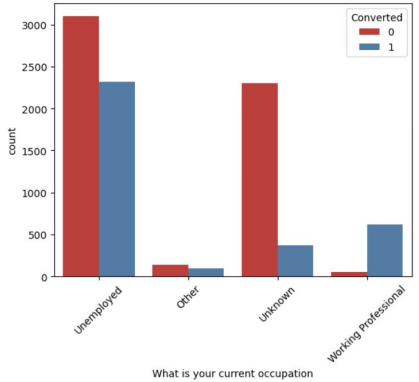
- Columns have ‘Yes’ or ‘No’ values are replaced with 1 and 0.
- Many of the categorical variables were having categories that are infrequent. If the percentage is less than the threshold of 5%, we are grouping them a ‘Other’ categories as they wouldn’t add much value to the analysis.
- Dummy variables are created all the categorical variables. The categories with the ‘_Other’ prefix are dropped to make the data relevant. The original columns are also removed to remove duplicates.

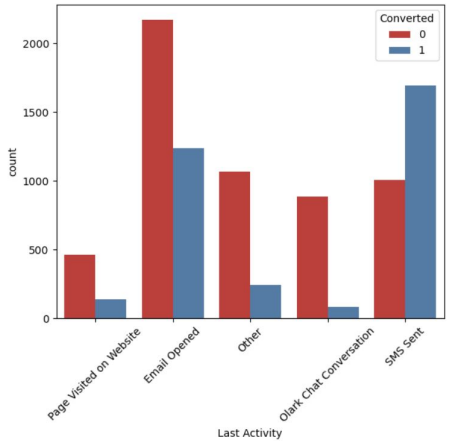
Categorical variables after grouping to Other category

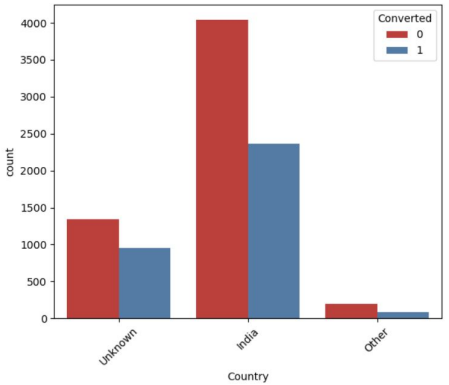


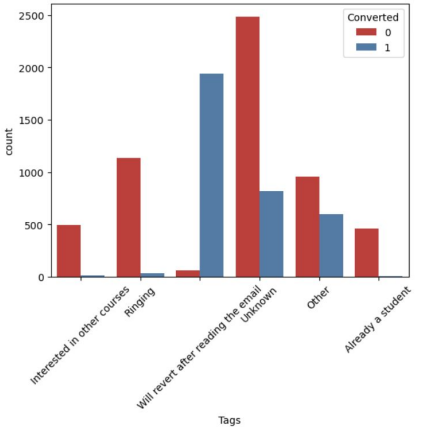


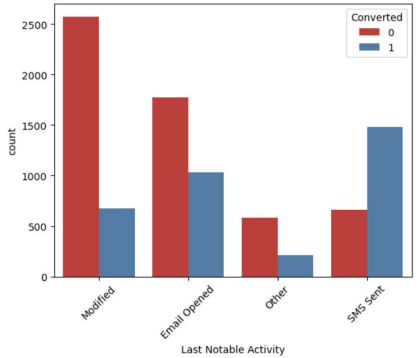




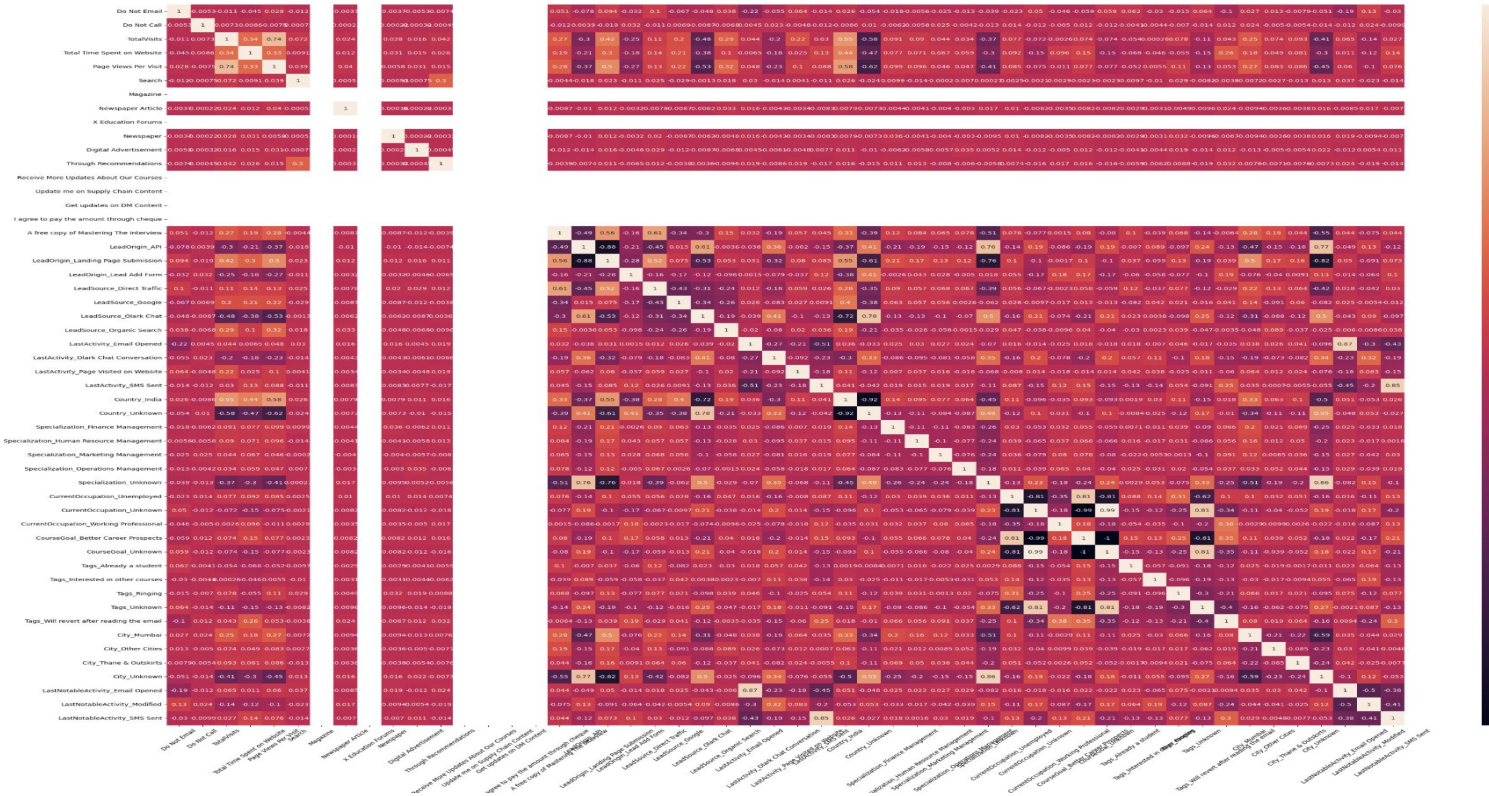








Correlation between variables



Model building summary

Using RFE, the following features have been identified, and below is the model summary

	Features	VIF
5	Country_Unknown	1.96
11	Tags_Will revert after reading the email	1.89
7	CourseGoal_Unknown	1.83
4	LastActivity_SMS Sent	1.72
3	LastActivity_Email Opened	1.71
12	LastNotableActivity_Modified	1.62
2	LeadOrigin_Lead Add Form	1.45
1	Total Time Spent on Website	1.42
10	Tags_Ringing	1.35
6	CurrentOccupation_Working Professional	1.29
9	Tags_Interested in other courses	1.18
8	Tags_Already a student	1.13
0	Do Not Email	1.12

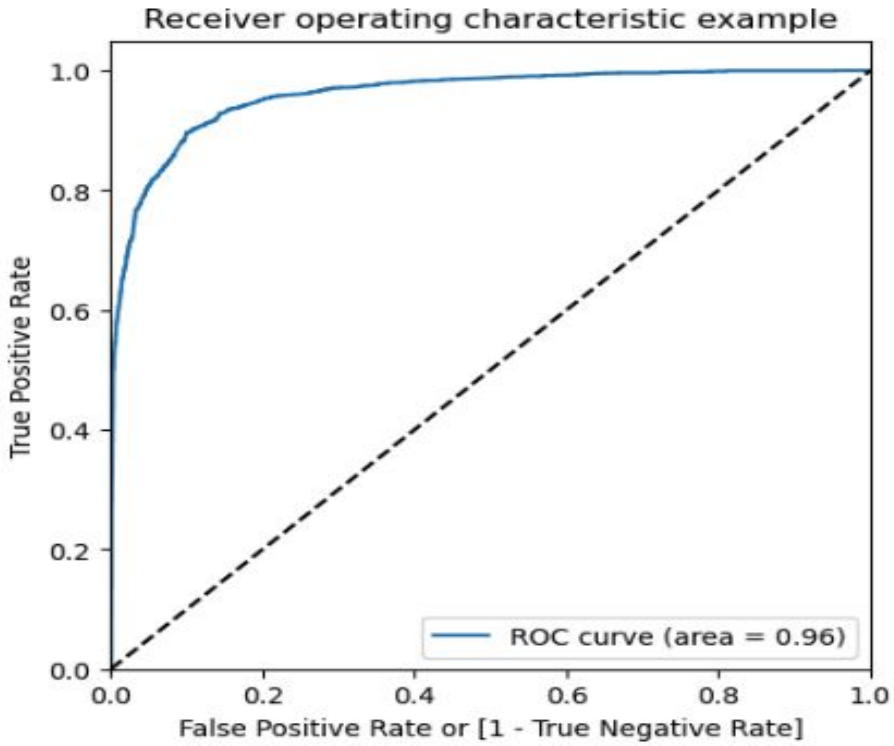
Generalized Linear Model Regression Results

Dep. Variable:	Converted	**No. Observations:**	6293
Model:	GLM	**Df Residuals:**	6279
Model Family:	Binomial	**Df Model:**	13
Link Function:	Logit	**Scale:**	1.0000
Method:	IRLS	**Log-Likelihood:**	-1546.3
Date:	Tue, 17 Dec 2024	**Deviance:**	3092.7
Time:	20:11:11	**Pearson chi2:**	7.69e+03
No. Iterations:	9	**Pseudo R-squ. (CS):**	0.5652
Covariance Type:	nonrobust		

	coef	std err	z	P>|z|	[0.025	0.975]
const	-1.1708	0.134	-8.762	0.000	-1.433	-0.909
Do Not Email	-1.4677	0.224	-6.566	0.000	-1.906	-1.030
Total Time Spent on Website	1.1826	0.055	21.337	0.000	1.074	1.291
LeadOrigin_Lead Add Form	3.0270	0.302	10.035	0.000	2.436	3.618
LastActivity_Email Opened	0.4180	0.130	3.227	0.001	0.164	0.672
LastActivity_SMS Sent	1.7340	0.132	13.139	0.000	1.475	1.993
Country_Unknown	1.3922	0.135	10.332	0.000	1.128	1.656
CurrentOccupation_Working Professional	1.3303	0.288	4.623	0.000	0.766	1.894
CourseGoal_Unknown	-1.4200	0.104	-13.649	0.000	-1.624	-1.216
Tags_Already a student	-5.2729	1.017	-5.186	0.000	-7.266	-3.280
Tags_Interested in other courses	-2.9827	0.346	-8.629	0.000	-3.660	-2.305
Tags_Ringing	-4.0646	0.240	-16.954	0.000	-4.535	-3.595
Tags_Will revert after reading the email	3.3002	0.182	18.144	0.000	2.944	3.657
LastNotableActivity_Modified	-0.7037	0.109	-6.464	0.000	-0.917	-0.490

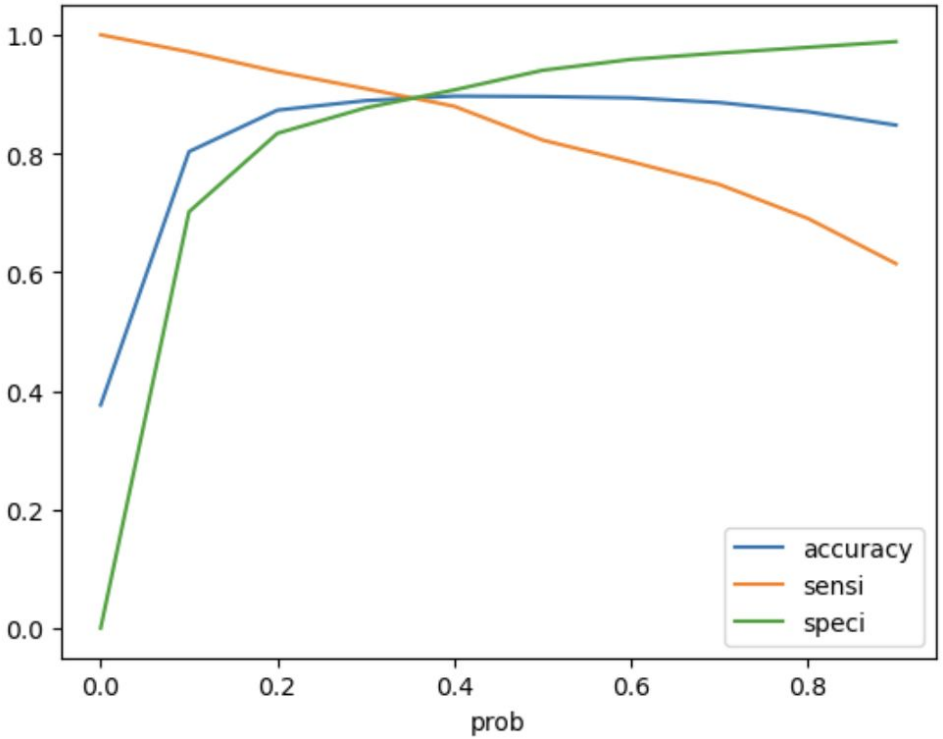
Plotting the ROC curve

The ROC curve is having an area of 0.96 which indicates the model is having very high discriminatory power



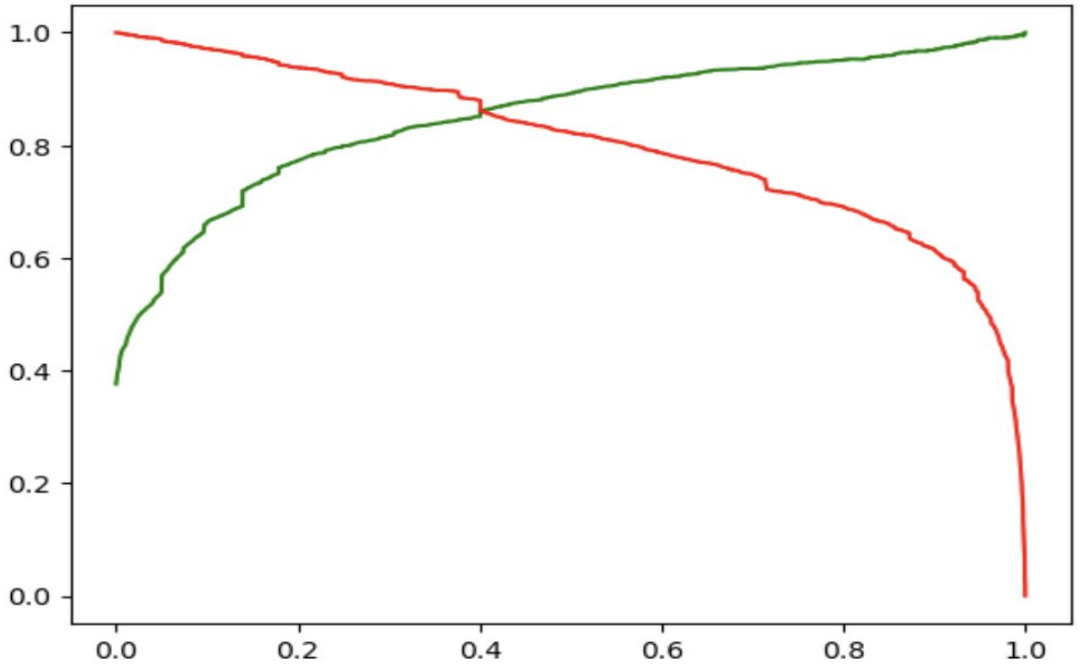
Finding optimal cut-off point

- Using ROC curve, we are finding a cutoff value of 0.35. With this cutoff, we are getting below metrics on the training data.
- Accuracy - 89.62%
- Sensitivity - 89.78%
- Specificity - 89.53%



Precision and recall trade-off

Precision and recall have a meeting point at around 0.4.



Final metrics

Train data metrics

- Accuracy: 89.62%
- Sensitivity: 89.78%
- Specificity: 89.53%
- False positive rate: 10.47%
- Positive predictive value: 83.79%
- Negative predictive value: 93.56%

Test data metrics

- Accuracy: 88.88%
- Sensitivity: 84.69%
- Specificity: 91.48%
- False positive rate: 8.52%
- Positive predictive value: 86.02%
- Negative predictive value: 90.61%

Key Insights

- Top Variables Contributing to Lead Conversion (based on coefficients and RFE selection):
  - Total Time Spent on Website
  - LastActivity_SMS Sent
  - LeadOrigin_Lead Add Form
- Model Performance
  - The model achieved consistent accuracy, sensitivity, and specificity on both train and test data.
  - Sensitivity on test data (84.69%) meets the business requirement of identifying most potential leads for conversion.
- Lead Scores
  - Higher probabilities (>35% threshold) are mapped to higher lead scores, enabling targeted follow-ups.