



Identifying Hot Leads

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agenda

Business Problem

PRIMARY GOALS

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Summary

Business Problem

An education company named X Education sells online courses to industry professionals. On any given day, many professionals who are interested in the courses land on their website and browse for courses.

The company markets its courses on several websites and search engines like Google. Once these people land on the website, they might browse the courses or fill up a form for the course or watch some videos. When these people fill up a form providing their email address or phone number, they are classified to be a lead. Moreover, the company also gets leads through past referrals. Once these leads are acquired, employees from the sales team start making calls, writing emails, etc. Through this process, some of the leads get converted while most do not. The typical lead conversion rate at X education is around 30%.

X Education has appointed you to help them select the most promising leads, i.e. the leads that are most likely to convert into paying customers. The company requires you to build a model wherein you need to assign a lead score to each of the leads such that the customers with a higher lead score have a higher conversion chance and the customers with a lower lead score have a lower conversion chance. The CEO, in particular, has given a ballpark of the target lead conversion rate to be around 80%.



The background features a light gray base with large, organic, overlapping shapes in muted olive green and dusty rose. In the top left corner, there are stylized, layered illustrations of foliage, including what appears to be a pine branch and some feathery leaves. A thin, white, wavy line curves across the bottom right portion of the image.

primary
goals

There are quite a few goals for this case study:

- Build a logistic regression model to assign a lead score between 0 and 100 to each of the leads which can be used by the company to target potential leads. A higher score would mean that the lead is hot, i.e. is most likely to convert whereas a lower score would mean that the lead is cold and will mostly not get converted.
- There are some more problems presented by the company which your model should be able to adjust to if the company's requirement changes in the future so you will need to handle these as well. These problems are provided in a separate doc file. Please fill it based on the logistic regression model you got in the first step. Also, make sure you include this in your final PPT where you'll make recommendations.

DATA READING AND INSPECTIONS

- There were **9240 leads** available in the data with **35 variables** to start analysing.
- 5 Numerical variables & 29 Categorical variables excluding Dependent variable
- Columns like **Prospect ID & Lead Number** are dropped as they were not useful
- Columns have missing value whether it is Category feature or Numerical Feature.
- For binary feature with Yes or No are replaced with 1 & 0
- For category variables, Missing value and Select Option are merged together to form single Missing class.
- Features namely **Do Not Call, Search, Magazine, Newspaper Article, X Education Forums, Newspaper, Digital Advertisement, Through Recommendations, Receive More Updates About Our Courses, Update me on Supply Chain Content, Get updates on DM Content, I agree to pay the amount through cheque** are dropped as they were 0 variance features. Discussed on next page.

Basic info for all variables available

Using data.info() Looking at the basic info of the columns such as:

- Count of variables
- Datatype of variable
- Non null values count to estimate missing i.e. Nan
- Incorrectly labelled variable

#	Column	Non-Null	Count	Dtype
0	Lead Origin	9240	non-null	object
1	Lead Source	9240	non-null	object
2	Do Not Email	9240	non-null	object
3	Do Not Call	9240	non-null	object
4	Converted	9240	non-null	int64
5	TotalVisits	9103	non-null	float64
6	Total Time Spent on Website	9240	non-null	int64
7	Page Views Per Visit	9103	non-null	float64
8	Last Activity	9240	non-null	object
9	Country	9240	non-null	object
10	Specialization	9240	non-null	object
11	How did you hear about X Education	9240	non-null	object
12	What is your current occupation	9240	non-null	object
13	What matters most to you in choosing a course	9240	non-null	object
14	Search	9240	non-null	object
15	Magazine	9240	non-null	object
16	Newspaper Article	9240	non-null	object
17	X Education Forums	9240	non-null	object
18	Newspaper	9240	non-null	object
19	Digital Advertisement	9240	non-null	object
20	Through Recommendations	9240	non-null	object
21	Receive More Updates About Our Courses	9240	non-null	object
22	Tags	9240	non-null	object
23	Lead Quality	9240	non-null	object
24	Update me on Supply Chain Content	9240	non-null	object
25	Get updates on DM Content	9240	non-null	object
26	Lead Profile	9240	non-null	object
27	City	9240	non-null	object
28	Asymmetrique Activity Index	9240	non-null	object
29	Asymmetrique Profile Index	9240	non-null	object
30	Asymmetrique Activity Score	5022	non-null	float64
31	Asymmetrique Profile Score	5022	non-null	float64
32	I agree to pay the amount through cheque	9240	non-null	object
33	A free copy of Mastering The Interview	9240	non-null	object
34	Last Notable Activity	9240	non-null	object



DATA PREPARATION & EDA

- Encoding
- Dropping redundant
- Merging less used Classes
- Dealing with missing data

Calculating Variable's nulls count

Code used:

- `[print(i,data[i].isna().sum())for i in data.columns if data[i].isna().sum()>0]`
- Above code is used to find the features that have the missing values in them.
- Most missing data was in Lead Quality
- Also *Asymmetrique Activity Index,Asymmetrique Profile Index,Asymmetrique Activity Score,Asymmetrique Profile Score* all have same missing value.
- Variables with missing value percentage more than 40% are dropped.

Variables	Count
Lead Source	0036
TotalVisits	0137
Page Views Per Visit	0137
Last Activity	0103
Country	2461
Specialization	1438
How did you hear about X Education	2207
What is your current occupation	2690
What matters most to you in choosing a course	2709
Tags	3353
Lead Quality	4767
Lead Profile	2709
City	1420
Asymmetrique Activity Index	4218
Asymmetrique Profile Index	4218
Asymmetrique Activity Score	4218
Asymmetrique Profile Score	4218

Dropping 0 variance Features

```
Do Not Call Do Not Call
0 0.999784
1 0.000216
Name: proportion, dtype: float64
Search Search
0 0.998485
1 0.001515
Name: proportion, dtype: float64
Magazine Magazine
0 1.0
Name: proportion, dtype: float64
Newspaper Article Newspaper Article
0 0.999784
1 0.000216
Name: proportion, dtype: float64
X Education Forums X Education Forums
0 0.999892
1 0.000108
Name: proportion, dtype: float64
Newspaper Newspaper
0 0.999892
1 0.000108
Name: proportion, dtype: float64
Digital Advertisement Digital Advertisement
0 0.999567
1 0.000433
```

These variables are dropped due to zero variance i.e. one class is present 99%.
Refer to attached images for more information

```
Digital Advertisement Digital Advertisement
0 0.999567
1 0.000433
Name: proportion, dtype: float64
Through Recommendations Through Recommendations
0 0.999242
1 0.000758
Name: proportion, dtype: float64
Receive More Updates About Our Courses Receive More Updates About Our Courses
0 1.0
Name: proportion, dtype: float64
Update me on Supply Chain Content Update me on Supply Chain Content
0 1.0
Name: proportion, dtype: float64
Get updates on DM Content Get updates on DM Content
0 1.0
Name: proportion, dtype: float64
I agree to pay the amount through cheque I agree to pay the amount through cheque
0 1.0
```

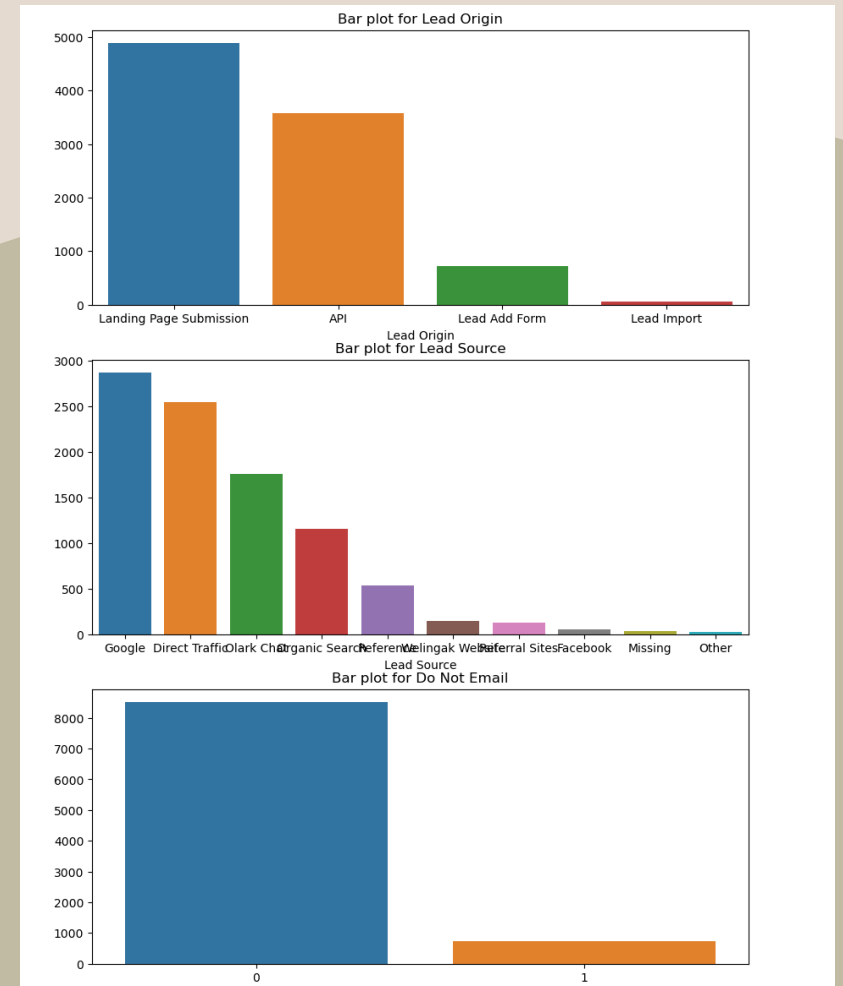
Other Categorical Variables dropped

Variables that were dropped other than 0 variance features. Variables that are dropped along with the reason are mentioned in the table

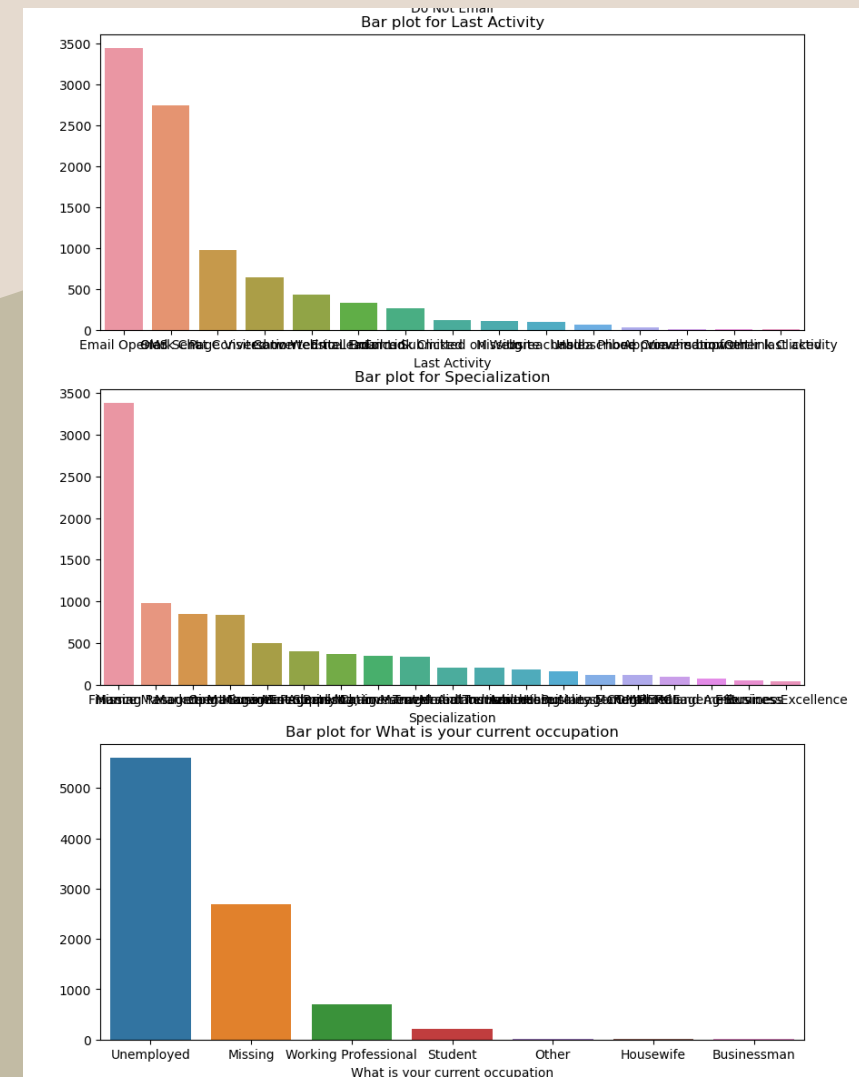
Variables	Reason
Prospect ID	Redundant data
Lead Number	Redundant data
Lead Quality	Dropped because feature is based on employee intuitions
Asymmetrique Activity Index	Dropped due to high percentage of missing values
Asymmetrique Profile Index	Dropped due to high percentage of missing values
Lead Profile	High percent data missing
How did you hear about X Education	Dropped due to high missing value percentage
Country	Due to 95 percent data is belong to India or missing

Univariate Analysis Action

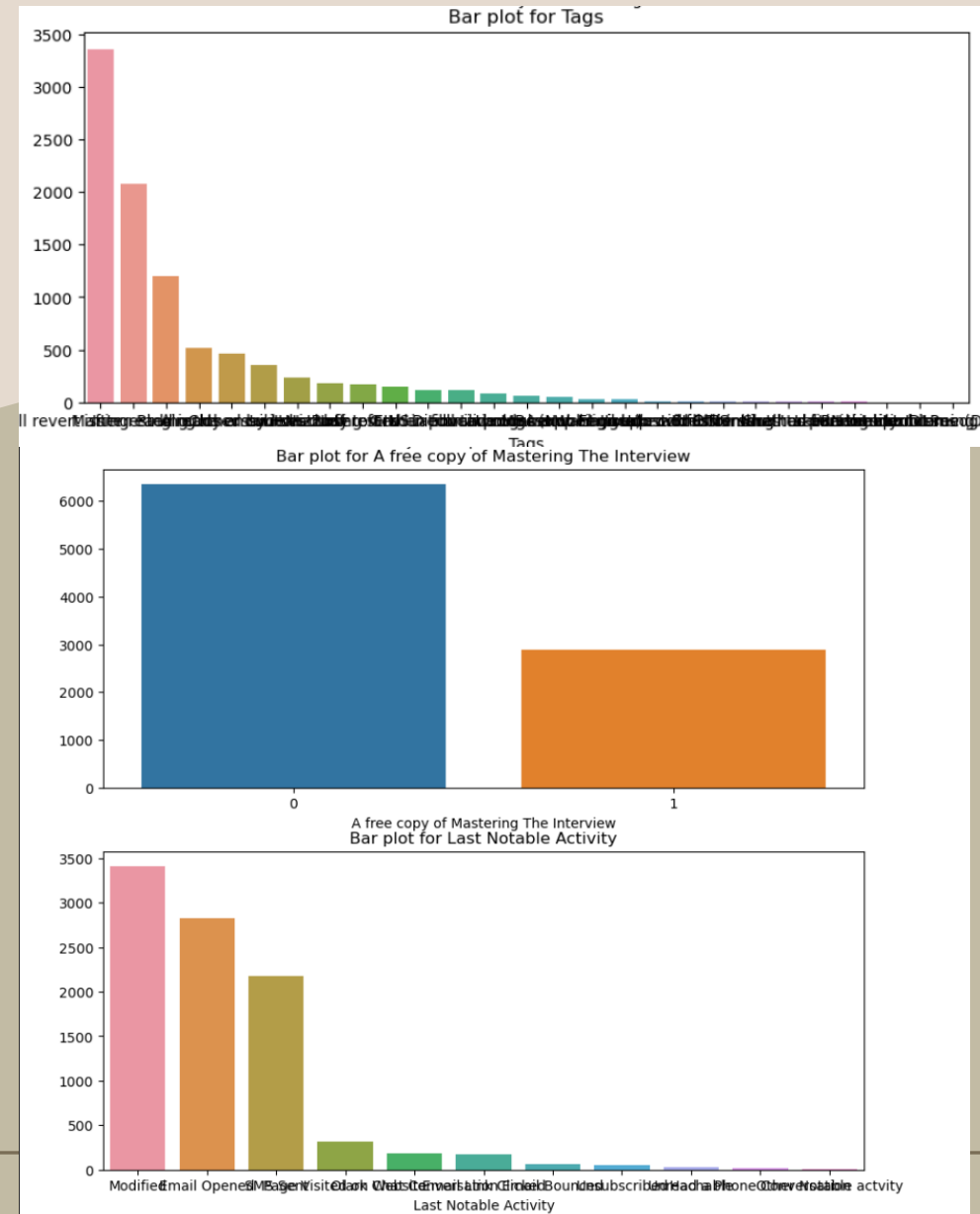
- In Lead Origin variable **Quick Add Form** has single count so it is merged with **Lead Import**
- In Lead source all the classes having count smaller than 5 i.e. **bing,,google,,Click2call, Press_Release, Social Media, Live Chat, youtubechannel, testone, Pay per Click Ads, welearnblog_Home, WeLearn, blog, NC_EDM** are merged to make single class **Other**
- In **Do not email** Yes and no are converted into binary number 1 & 0
- Graphs shown are post action applied



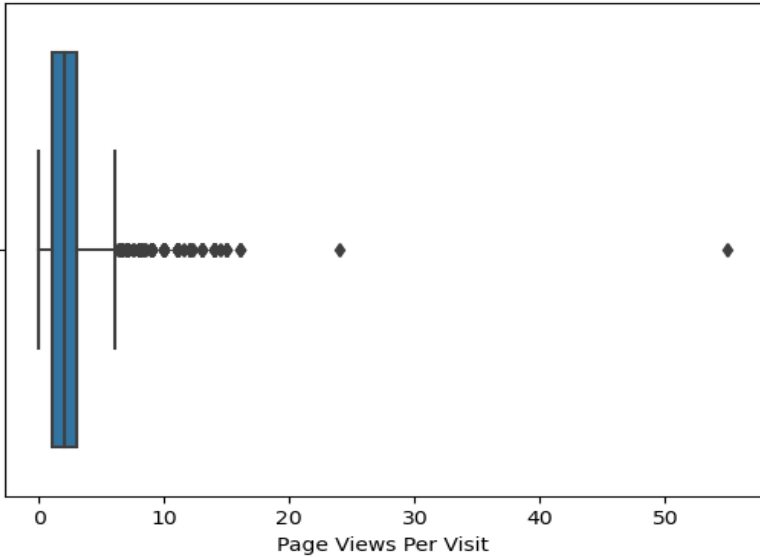
- In last Activity variables Email Opened, SMS Sent, Olark Chat Conversation, Page Visited on Website, Converted to Lead, Email Bounced, Email Link Clicked, Form Submitted on Website, Missing, Unreachable, Unsubscribed, Had a Phone Conversation, Approached upfront, View in browser link Clicked, Email Received, Email Marked Spam, Visited Booth in Tradeshow, Resubscribed to emails are merged into 1 class **Other last activity**
- For **Specilization** Variable all Select are merged as **Missing** Class



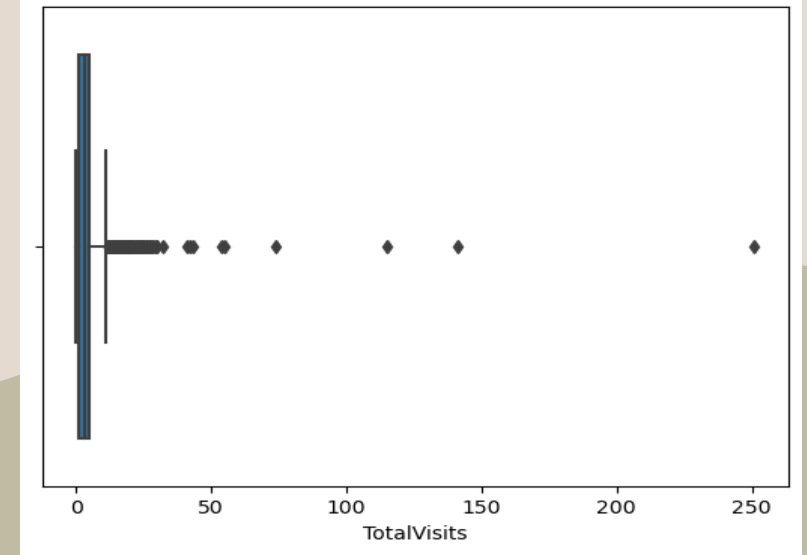
- Variable **A free copy of Mastering the Interview** was converted into 0 & 1 for respective NO and Yes.
- In **Last Notable Activity** the classes **Email Marked Spam, Approached upfront, Resubscribed to emails, View in browser link Clicked, Form Submitted on Website, Email Receive** are merged into **Other Notable activity** due to less count



Numerical Variables analysis



Page Views Per Visit		TotalVisits
9103.000000	count	9103.000000
2.362820	mean	3.445238
2.161418	std	4.854853
0.000000	min	0.000000
2.000000	50%	3.000000
4.000000	80%	5.000000
5.000000	90%	7.000000
6.000000	95%	10.000000
9.000000	99%	17.000000
55.000000	max	251.000000



- Per views per visit also appears to have outliers 55.
- When observed carefully there is only 5 cases having Page per visit more than 15.
- This can be due to curiosity of Person
- Missing values are filled with Median values

- Variable TotalVisits appear to have outliers 251
- But on further investigation 99% have 17 TotalVisit while only 10 cases of visit more than 30.
- This can be the case that people either waiting for price drop or any offer or for specific course
- Missing values are filled with Median values

Encoding Category and feature scaling

- Category variables Lead Origin, Lead Source, Do Not Email, Last Activity, Specialization, What is your current occupation, What matters most to you in choosing a course, Tags, City, A free copy of Mastering The Interview, Last Notable Activity are encoded using `pandas.get_dummies()`
- And Numerical Columns Total Time Spent on Website, TotalVisits, Page Views Per Visit are Standardised using `StandardScaler()`

Model creation and Optimization

Model Summary

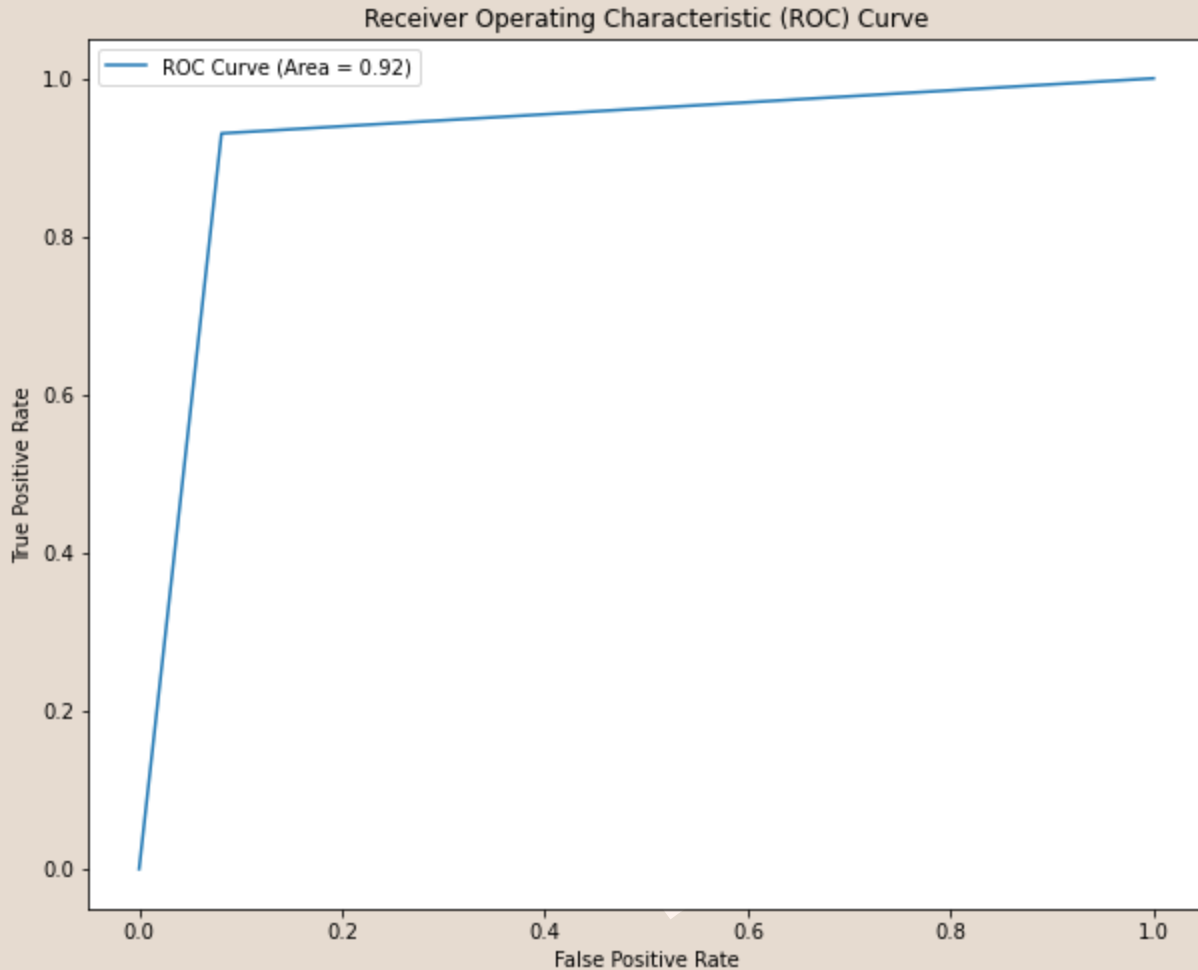
Multiple models are made and tested and optimised for better efficiency and reduced Variables using technique such as RFE, VIF and Custom fine tuning using Model Summary.

Important Features for Model

- Tags
- Lead Source
- Last Notable activity

Features	coef	std err	z	P> z	[0.025	0.975]
const	-4.4192	0.156	-28.365	0.000	-4.725	-4.114
Lead Source_Welingak Website	3.5935	1.018	3.530	0.000	1.598	5.589
Tags_Busy	3.6010	0.252	14.262	0.000	3.106	4.096
Tags_Closed by Horizon	9.9022	1.014	9.764	0.000	7.915	11.890
Tags_Lost to EINS	10.6054	1.030	10.296	0.000	8.587	12.624
Tags_Missing	4.4575	0.186	23.947	0.000	4.093	4.822
Tags_Will revert after reading the email	7.2919	0.216	33.698	0.000	6.868	7.716
Tags_switched off	-1.7262	0.728	-2.370	0.018	-3.154	-0.298
Lead Profile_Missing	-2.4753	0.138	-17.993	0.000	-2.745	-2.206
Last Notable Activity_SMS Sent	2.5453	0.124	20.478	0.000	2.302	2.789

ROC curve and model Evaluations



Model is good it have AUC = 0.91 indicating good model

Model evaluation on training data:

Recall Score: **92%**

Precision Score **89%**

Accuracy **92%**

Specificity **93%**

False Negative Rate **08%**

Model Evaluation for test data:

Recall Score **93%**

Precision Score **88%**

Accuracy **92%**

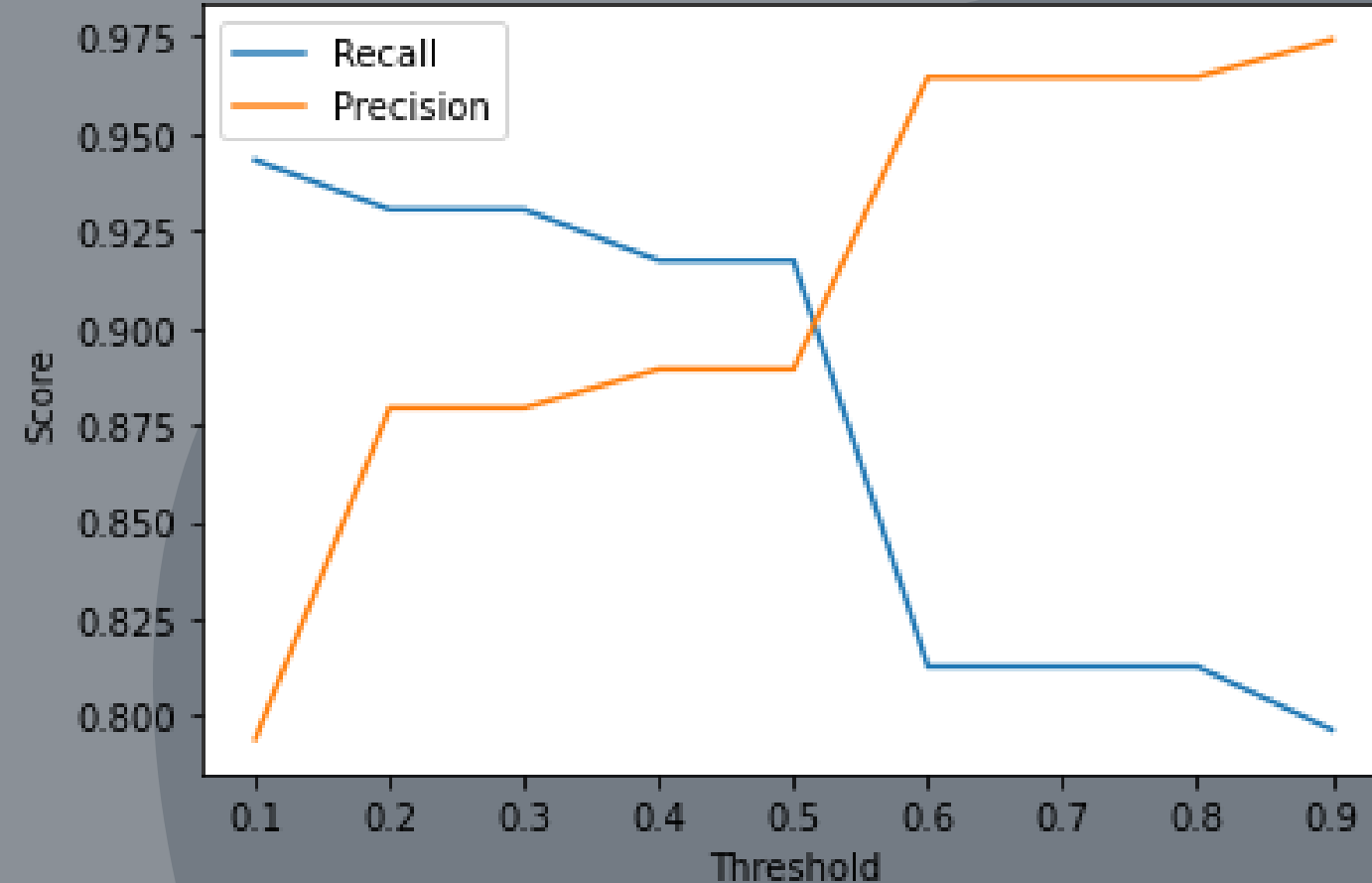
Specificity **92%**

False Negative Rate **07%**

Finding Threshold

Finding the optimal value i.e. Threshold

Precision-Recall Trade-off



- Threshold value is obtained by plotting various value of Recall score and Precision score on the same plot against values of threshold.
- Threshold value find out to be 0.505556
- Or on other word any lead with score more than 51 is a potential **Hot Lead**

summary

- The model provide Score to each lead on a scale of 0 to 100 higher the number more is the probability of getting into converted.
- Any lead with a Lead score more than 51(threshold) can be considered as Hot Lead.
- Model have a accuracy of 92% and a average false positive rate of 7.5 %.





thank you

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