Lead Score Group Assignment

DS C72

Submitted by: Karthikein M R, Kruthika K S, and Pham Kieu Linh

Index

- Problem Statement
- Data preprocessing
- Exploratory Data Analysis
- Model Building
- Model Evaluation
- Conclusion

Problem Statement

- **Company:** X Education, an online course provider.
- **Challenge:** Low lead conversion rate (~30%) despite generating numerous leads daily.
- **Objective:** Develop a **Lead Scoring Model** using **Logistic Regression**.
- **Approach:** Assign a lead score between **0 and 100** to prioritize potential leads.
- **Goal:** Improve sales efficiency and **increase the conversion rate to ~80%**.

Data Preprocessing

Summary

1. Handling Missing Data

- **Dropped columns with >45% missing values** if insignificant (e.g., Asymmetrique Index & Score). However Lead Quality was kept despite 51% missing as it might impact on conversion rate.
- Imputed missing values with **mode** or labeled as **'unknown'**
- Treated **'Select'** responses as missing and replaced them with **'unknown'.**

2. Feature Selection:

- Removed columns with o**nly one value** (e.g., Magazine, Supply Chain Content).
- Grouped **low-frequency categories** into **'Other'** to reduce dimensionality.

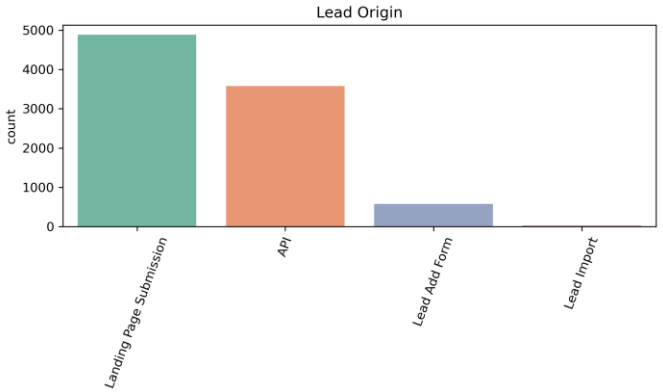
3. Outlier Treatment:

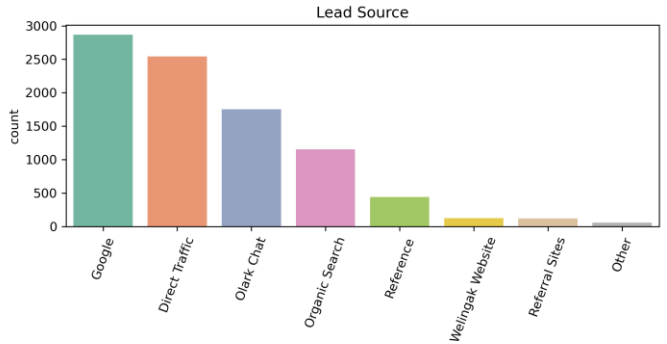
Outliers in Total Visits & Page Views Per Visit were identified but **retained** as they were **business-relevant**.

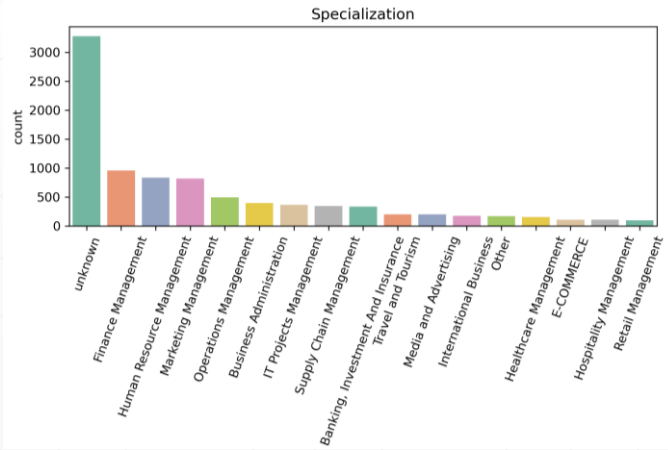
Exploratory Data Analysis

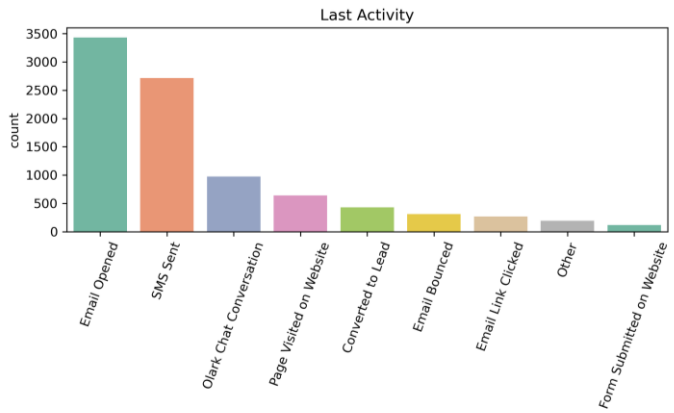
Univariate Analysis

Categorical columns









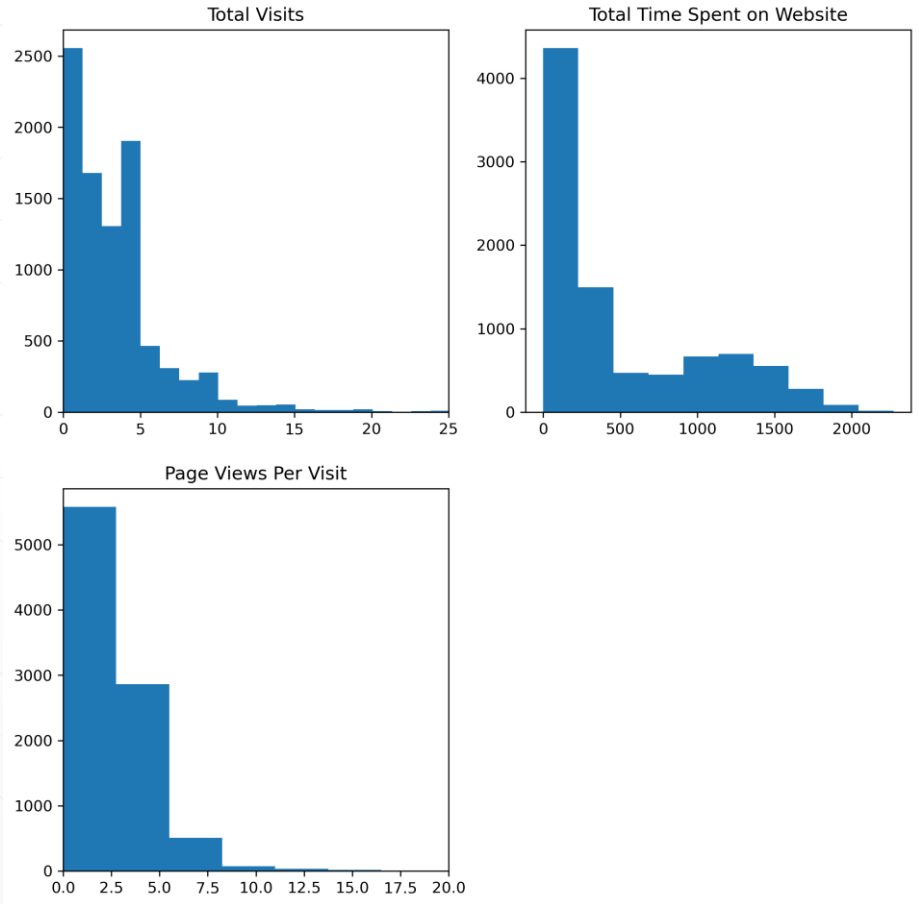
- **Lead Origin:** The majority of leads come from "Landing Page Submission," indicating that website visitors are a major source of potential customers.
- **Lead Source:** "Google" and "Direct Traffic" contribute significantly to lead generation, while other sources have lower representation.
- **Specialization:** The most common specializations among leads are "Marketing Management", "Human Resource Management" and "Finance Management," suggesting these fields have high interest in courses.
- **Last Activity:** "Email Opened" and "SMS Sent" are the most frequent activities, implying that email and SMS marketing play a crucial role in engagement.

Exploratory Data Analysis

Univariate Analysis

Numerical columns

- **Skewed Distribution:** All three metrics—Total Visits, Total Time Spent on Website, and Page Views Per Visit—are highly right-skewed, indicating that most users have low engagement, while a few spend significantly more time or visit more pages.
- **Majority of Users Have Low Interaction**: Most users have fewer than 5 total visits, less than 500 seconds spent on the website, and under 3 page views per visit, suggesting that engagement strategies may be needed to retain visitors and increase conversions.

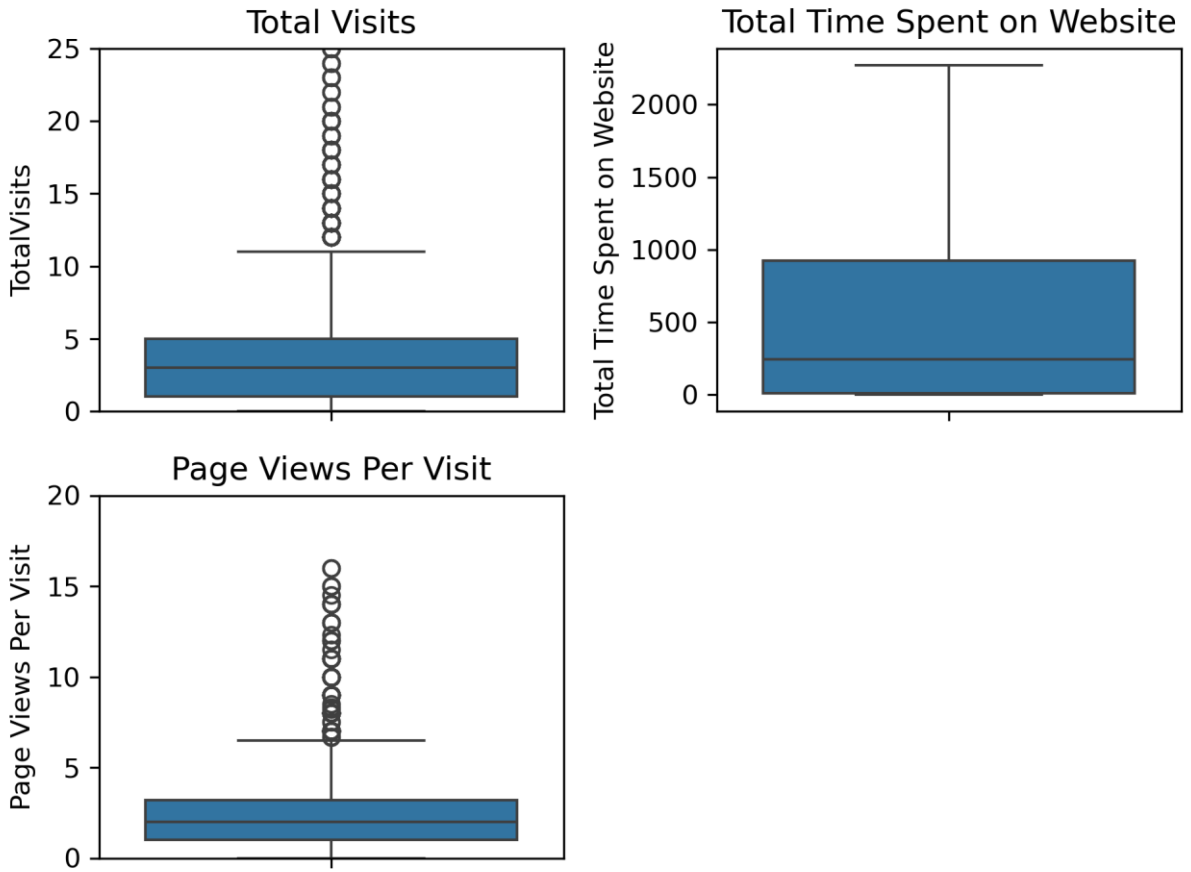


Exploratory Data Analysis

Univariate Analysis

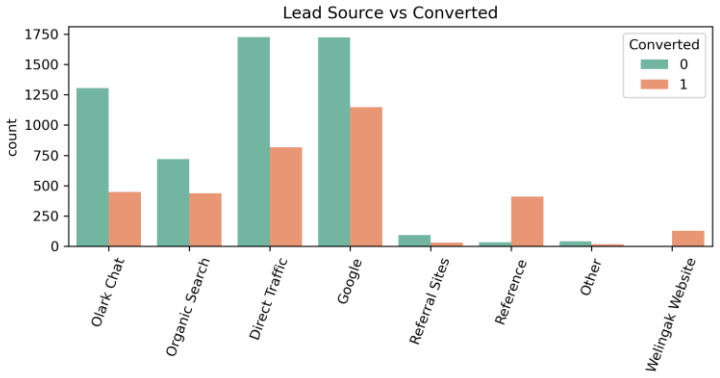
Numerical columns for checking outliers

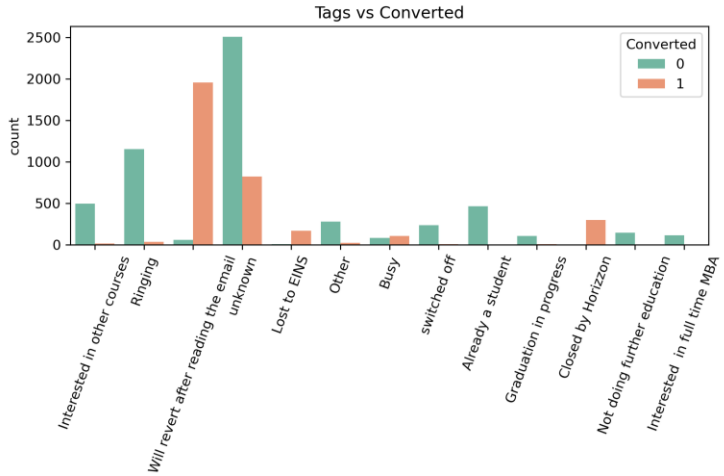
- **Presence of Outliers:** The Total Visits and Page Views Per Visit metrics have a significant number of outliers, indicating that a small group of users engage with the website much more frequently than the majority. These high-activity users may represent highly interested leads.
- In this case, the outliers are not due to incorrect data but are logically valid from a business perspective. Therefore, they are retained in the analysis

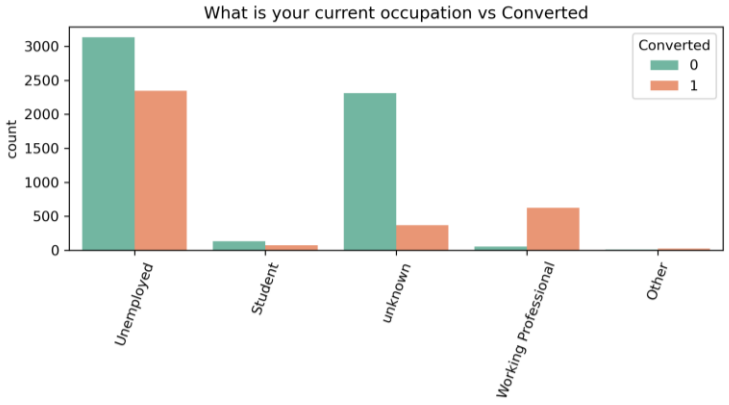


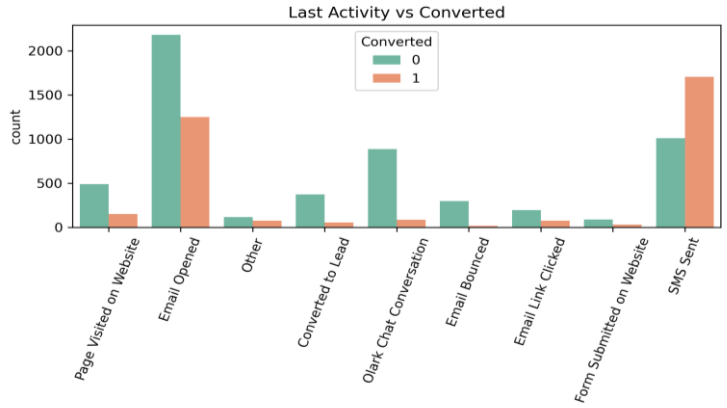
Exploratory Data Analysis

Bivariate Analysis









- **Lead Source Impact:** Leads coming from the "Welingak Website" and "Reference" have a significantly higher conversion rate compared to other sources, indicating a strong trust factor.
- **Tags Influence:** Leads tagged as "Will revert after reading the email" shows a higher likelihood of conversion, suggesting that engagement signals are valuable in predicting lead quality.
- **Occupation Matters:** Working professionals have a noticeably higher conversion rate than students or unemployed individuals, likely due to their financial capability to invest in education.
- **Last Activity Effect:** Leads whose last activity involved "SMS Sent" have a higher conversion rate, emphasizing the effectiveness of direct and personalized communication.

Model Building

Approach

A Logistic Regression Model was chosen for its interpretability and effectiveness in binary classification. The dataset was split into train (70%) and test (30%). Key steps included:

- **Data Preprocessing**: Applied one-hot encoding and Min-Max scaling.
- **Feature Selection**: Used Recursive Feature Elimination (RFE) and Variance Inflation Factor (VIF) to retain relevant predictors and eliminate multicollinearity.
- The **cut-off point was chosen based on the Sensitivity-Specificity Intersection**. Since this problem requires balancing between converted and non-converted customers while the dataset is not highly imbalanced, selecting the intersection of Sensitivity and Specificity as the optimal cut-off ensures a well-generalized model that minimizes both false positives and false negatives

Model Building

Result

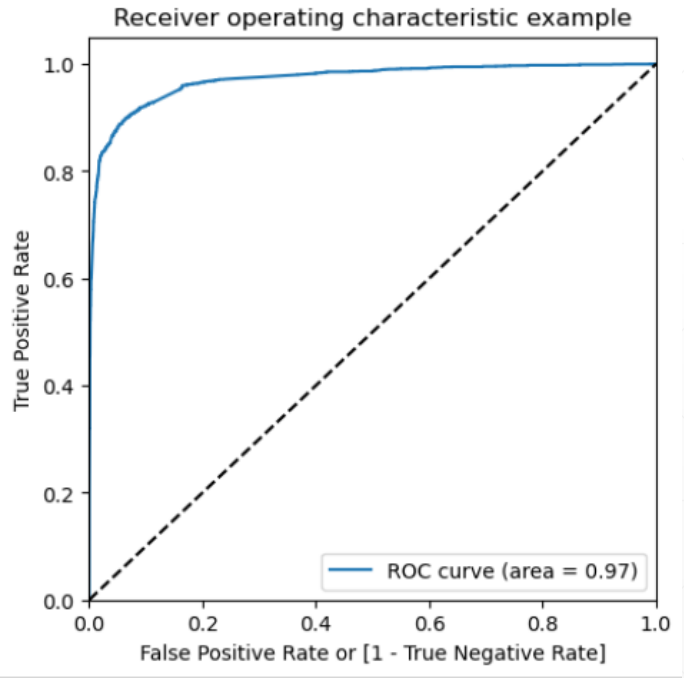
	coef	std err	z	P>|z|	[0.025	0.975]
const	-3.0170	0.134	-22.516	0.000	-3.280	-2.754
Total Time Spent on Website	4.7992	0.255	18.791	0.000	4.299	5.300
Lead Source_Welingak Website	4.9626	1.022	4.858	0.000	2.960	6.965
Last Activity_Email Bounced	-1.9022	0.487	-3.906	0.000	-2.857	-0.948
Country_unknown	1.4938	0.145	10.284	0.000	1.209	1.778
What is your current occupation_unknown	-0.9436	0.118	-7.976	0.000	-1.175	-0.712
Tags_Busy	0.7279	0.244	2.978	0.003	0.249	1.207
Tags_Closed by Horizzon	6.2138	0.736	8.441	0.000	4.771	7.657
Tags_Lost to EINS	5.8633	0.601	9.762	0.000	4.686	7.040
Tags_Ringing	-3.6896	0.247	-14.961	0.000	-4.173	-3.206
Tags_Will revert after reading the email	4.5790	0.199	23.006	0.000	4.189	4.969
Tags_switched off	-4.6898	0.745	-6.295	0.000	-6.150	-3.230
Lead Quality_Worst	-3.8314	0.565	-6.782	0.000	-4.939	-2.724
Last Notable Activity_Other	1.3356	0.418	3.198	0.001	0.517	2.154
Last Notable Activity_SMS Sent	2.6957	0.128	21.052	0.000	2.445	2.947

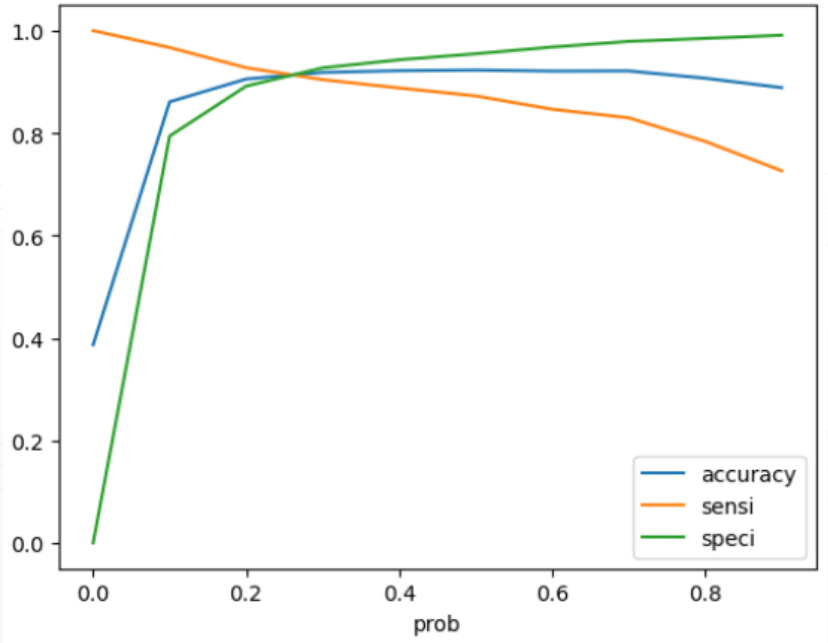
From a business standpoint, the following variables have a significant influence on lead conversion:

- **Time Spent on Website** (coefficient = 4.7992): The longer a person stays on the website, the more likely they are to convert.
- **Lead Source - Welingak Website** (coefficient = 4.9626): Leads coming from this website have a much higher chance of conversion.
- **Tags - Lost to EINS** (coefficient = 5.8633): Even though these leads were marked as "lost," they still have a strong chance of converting.

Model Evaluation

- The default threshold of **0.5** was initially used but was found to be suboptimal for balancing model performance.
- The **ROC Curve** shows that the model performs well with an **AUC of 0.97**, indicating a strong ability to distinguish between converted and non-converted leads.
- The **Sensitivity-Specificity Trade-off Curve** was used to determine the best cut-off





Final Decision:

- **0.25 was selected as the optimal cut-off** as it offers the best balance between correctly identifying converted leads (high sensitivity) and avoiding false positives (maintaining specificity).
- This cut-off ensures that the sales team can prioritize high-potential leads effectively while minimizing wasted outreach on unlikely conversions.

Model Building

Result

Evaluation Metric	Train Set	Test Set
Accuracy	91.30%	90.40%
Sensitivity (Recall)	91.80%	91.70%
Specificity	91%	89.70%
False Positive Rate	9%	10%
Positive Predictive Value	86.50%	83%
Negative Predictive Value	94.60%	95.10%

The model demonstrates strong generalization with minimal overfitting, as the accuracy remains high and consistent between the train set (91.3%) and test set (90.4%). Additionally, sensitivity (91.8% train, 91.7% test) and specificity (91% train, 89.7% test) indicate a well-balanced performance in identifying both converted and non-converted leads.

Suggestion

1. **Prioritize High-Scoring Leads:** Focus outreach (calls, emails) on leads with scores 80+ to maximize conversion efficiency.

2. **Optimize Marketing Efforts:** Invest in Welingak Website, website engagement, SMS campaign and follow-ups for leads tagged as "Will Revert After Reading Email" to improve conversion rates.

3. **Adjust Lead Handling by Business Phases:** Lower cut-off (e.g. 0.25) during peak sales for wider outreach; raise it (0.35 - 0.5) during slow periods to focus on high-quality leads.