ANALYZING WEBSITE TRAFFIC DATA

A PROJECT REPORT
for
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CERTIFICATE

Certified that **Khushi Jain (202410116100100), Mahima Goyal (202410116100112), Harsh Gupta (202410116100082)** has/ have carried out the project work having "**Analyzing Website Traffic Data**" (**Introduction To AI, AI101B**) for **Master of Computer Application** from Dr. A.P.J. Abdul Kalam Technical University (AKTU) (formerly UPTU), Lucknow under my supervision. The project report embodies original work, and studies are carried out by the student himself/herself and the contents of the project report do not form the basis for the award of any other degree to the candidate or to anybody else from this or any other University/Institution.

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ABSTRACT

This project focuses on an in-depth analysis of website traffic data to understand user behavior and optimize digital performance. The dataset includes key metrics such as Page Views, Session Duration, Bounce Rate, Traffic Source, Time on Page, Previous Visits, and Conversion Rate. By employing Python libraries like Pandas, Matplotlib, and Seaborn, we performed data cleaning, exploratory analysis, and comprehensive visualizations.

Through correlation heatmaps and interactive plots, we identified critical relationships between user engagement metrics and conversion outcomes. For instance, patterns in session duration and bounce rate revealed their direct impact on conversion rates, while traffic source distributions highlighted the most effective channels for acquiring high-quality traffic. The study also emphasized the role of repeat visits and content engagement (time on page) in influencing user conversions.

These insights not only assist in identifying performance bottlenecks but also support data-driven decision-making for marketing strategies, user experience improvements, and campaign targeting. The visually enhanced and insight-driven visualizations ensure that stakeholders can quickly interpret patterns and derive meaningful conclusions from the data.

ACKNOWLEDGEMENT

Success in life is never attained single-handedly. I am deeply grateful to my project supervisor, **Mr. Apoorv Jain**, for his invaluable guidance, unwavering support, and encouragement throughout my project work. His enlightening ideas, constructive comments, and thoughtful suggestions have greatly contributed to the completion of this project.

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Harsh Gupta

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INTRODUCTION

In today's digital landscape, the internet plays a pivotal role in how businesses connect with their customers. A website acts as the face of a brand, an information hub, and often a direct channel for conversions — be it product purchases, newsletter subscriptions, sign-ups, or service inquiries. As user interactions with websites increase, understanding the behavior and patterns of these interactions has become essential for businesses aiming to remain competitive and deliver optimal user experiences.

Website Traffic Analysis refers to the process of collecting, measuring, and analyzing web usage data to understand and improve website performance. It provides insights into how visitors find a website, how they interact with its content, and what drives them to take specific actions (or prevents them from doing so). This analysis is crucial for enhancing marketing strategies, optimizing user interfaces, increasing retention, and ultimately boosting conversion rates.

Purpose of the Project

The primary aim of this project is to analyse a website traffic dataset using data analysis techniques and visualization tools in Python. The dataset includes the following key metrics:

Page Views: Number of times a page has been viewed by users.
Session Duration: Time spent by a user during a single session.
Bounce Rate: The percentage of visitors who leave after viewing only one page.
Traffic Source: The channel from which the user arrived (e.g., Organic, Direct, Referral).
Time on Page: The average amount of time spent on a single page.
Previous Visits: Number of times a user has visited the site before the current session.
Conversion Rate: The percentage of users who completed a desired action.

These metrics were chosen because they offer deep insights into both user engagement and website effectiveness.

Why Does Website Traffic Analysis Matters?

A thorough website traffic analysis helps in:

Identifying User Drop-off Points: High bounce rates may indicate poor landing pages or irrelevant traffic sources.
Improving Content Strategy: Pages with high time-on-page and multiple previous visits indicate content that retains users.

Optimizing Conversions: Understanding which traffic sources and user behaviors are linked to high conversion rates helps tailor marketing efforts.
Enhancing UI/UX Design: Analyzing session duration and navigation patterns can highlight usability issues.
Refining Marketing Campaigns: Knowing which traffic sources bring the highest quality visitors enables better targeting and budgeting.

Approach and Tools Used

To conduct this analysis, we utilized **Python** along with data science libraries like:

- **Pandas** for data cleaning and manipulation.
- **Matplotlib** and **Seaborn** for generating high-quality, eye-catching visualizations.
- **Correlation Heatmaps**, **Scatter Plots**, **Box Plots**, and **Line Graphs** were used to explore relationships between variables and uncover hidden trends in the data.

Each visualization was designed not only to be visually appealing but also to convey critical insights at a glance, helping stakeholders make quick, informed decisions.

Expected Outcomes

By the end of this project, we aim to:

- Derive actionable insights that explain user behavior.
- Understand which metrics most influence conversion.
- Provide clear visual representations of the data for better communication.
- Help decision-makers identify areas of improvement in their website's structure, content, or marketing strategy.

METHODOLOGY

The methodology for this project follows a structured approach to ensure a comprehensive analysis of website traffic data. The process includes data collection, preprocessing, exploratory data analysis, visualization, and interpretation of insights.

1. Data Collection

The dataset used for this analysis consists of essential website traffic metrics, including:

- **Page Views** – Number of times a webpage is viewed.
- **Session Duration** – Total time a user spends in a session.
- **Bounce Rate** – Percentage of users who leave without interacting further.
- **Traffic Source** – Origin of website traffic (Organic, Direct, Referral, etc.).
- **Time on Page** – Duration a user spends on a specific page.
- **Previous Visits** – Number of times a user has visited before.
- **Conversion Rate** – Percentage of visitors who complete a desired action.

The data was collected from web analytics tools such as Google Analytics or similar platforms, ensuring reliability and accuracy.

2. Data Preprocessing

- The dataset was imported using Python's **Pandas** library.
- Missing values were checked and handled appropriately.
- Categorical values such as 'Traffic Source' were converted into categorical format for better analysis.
- Outliers and inconsistencies were identified and managed to prevent skewed results.

3. Exploratory Data Analysis (EDA)

- **Summary statistics** were computed to understand the dataset's distribution and central tendencies.
- **Correlation analysis** was conducted to determine relationships between variables and identify key influencing factors.

4. Data Visualization

Visualization plays a crucial role in understanding patterns and user behavior. The following visualizations were created using **Seaborn** and **Matplotlib**:

- **Correlation Heatmap** – Displays the strength of relationships between numerical features.
- **Traffic Source Distribution** – Shows the proportion of users from different traffic sources.
- **Bounce Rate vs. Conversion Rate Scatter Plot** – Helps analyze if high bounce rates affect conversion rates.
- **Session Duration vs. Conversion Rate Scatter Plot** – Examines whether longer session durations increase conversions.
- **Time on Page vs. Conversion Rate** – Analyzes engagement time per page and its effect on conversion.
- **Box Plot of Session Duration across Traffic Sources** – Highlights variations in session durations based on traffic sources.
- **Line Plot of Previous Visits vs. Conversion Rate** – Shows how repeated visits impact conversions.

These visualizations provided actionable insights into user behavior, allowing for better website optimization strategies.

5. Insights and Interpretation

- Websites receiving traffic from **organic sources** showed higher engagement and conversion rates.
- **Short session durations** and **high bounce rates** negatively impacted conversions.
- **Returning visitors** had a significantly higher likelihood of converting compared to first-time visitors.
- Users spending more **time on pages** were more likely to convert, indicating that engaging content improves conversion rates.

6. Conclusion and Recommendations

Based on the findings, the following recommendations were made:

- Improve landing page engagement to **reduce bounce rates**.
- Optimize content and UI to increase **session duration**.
- Implement retargeting strategies for returning visitors to **boost conversions**.
- Enhance SEO efforts to maximize **organic traffic acquisition**.

CODE

```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns

# Load the dataset
df = pd.read_csv('/content/website_wata.csv')

# Display basic information and first few records
print("Dataset Overview:")
print(df.info())
print(df.head())

# Summary statistics
print("\nSummary Statistics:")
print(df.describe())

# Checking for missing values
print("\nMissing Values:")
print(df.isnull().sum())

# Convert categorical variable 'Traffic Source' to categorical type
df['Traffic Source'] = df['Traffic Source'].astype('category')

# Visualizing Correlation Heatmap (excluding non-numeric columns)
plt.figure(figsize=(12,6))
sns.heatmap(df.select_dtypes(include=['number']).corr(), annot=True, cmap='coolwarm', linewidths=0.5)
plt.title('Correlation Heatmap')
plt.show()

# Distribution of Traffic Sources
plt.figure(figsize=(10,6))
sns.countplot(x='Traffic Source', data=df, palette='viridis')
plt.title('Traffic Source Distribution')
plt.xlabel('Traffic Source')
plt.ylabel('Count')
plt.xticks(rotation=45)
plt.show()

# Relationship between Bounce Rate and Conversion Rate
plt.figure(figsize=(10,6))
sns.scatterplot(x='Bounce Rate', y='Conversion Rate', data=df, color='red', edgecolor='black', alpha=0.7)
plt.title('Bounce Rate vs Conversion Rate')
plt.xlabel('Bounce Rate')
plt.ylabel('Conversion Rate')
plt.grid(True)
plt.show()
```

```
# Relationship between Session Duration and Conversion Rate
plt.figure(figsize=(10,6))
sns.scatterplot(x='Session Duration', y='Conversion Rate', data=df, color='blue', edgecolor='black',
alpha=0.7)
plt.title('Session Duration vs Conversion Rate')
plt.xlabel('Session Duration')
plt.ylabel('Conversion Rate')
plt.grid(True)
plt.show()

# Time on Page vs. Conversion Rate
plt.figure(figsize=(10,6))
sns.scatterplot(x='Time on Page', y='Conversion Rate', data=df, hue='Traffic Source', palette='coolwarm',
alpha=0.8)
plt.title('Time on Page vs Conversion Rate by Traffic Source')
plt.xlabel('Time on Page')
plt.ylabel('Conversion Rate')
plt.legend(title='Traffic Source')
plt.grid(True)
plt.show()

# Boxplot for Session Duration across Traffic Sources
plt.figure(figsize=(12,6))
sns.boxplot(x='Traffic Source', y='Session Duration', data=df, palette='Set2')
plt.title('Session Duration Distribution Across Traffic Sources')
plt.xlabel('Traffic Source')
plt.ylabel('Session Duration')
plt.xticks(rotation=45)
plt.grid(True)
plt.show()

# Line plot to analyze previous visits vs. conversion rate
plt.figure(figsize=(10,6))
sns.lineplot(x='Previous Visits', y='Conversion Rate', data=df, marker='o', color='purple', linewidth=2)
plt.title('Previous Visits vs Conversion Rate')
plt.xlabel('Previous Visits')
plt.ylabel('Conversion Rate')
plt.grid(True)
plt.show()
```

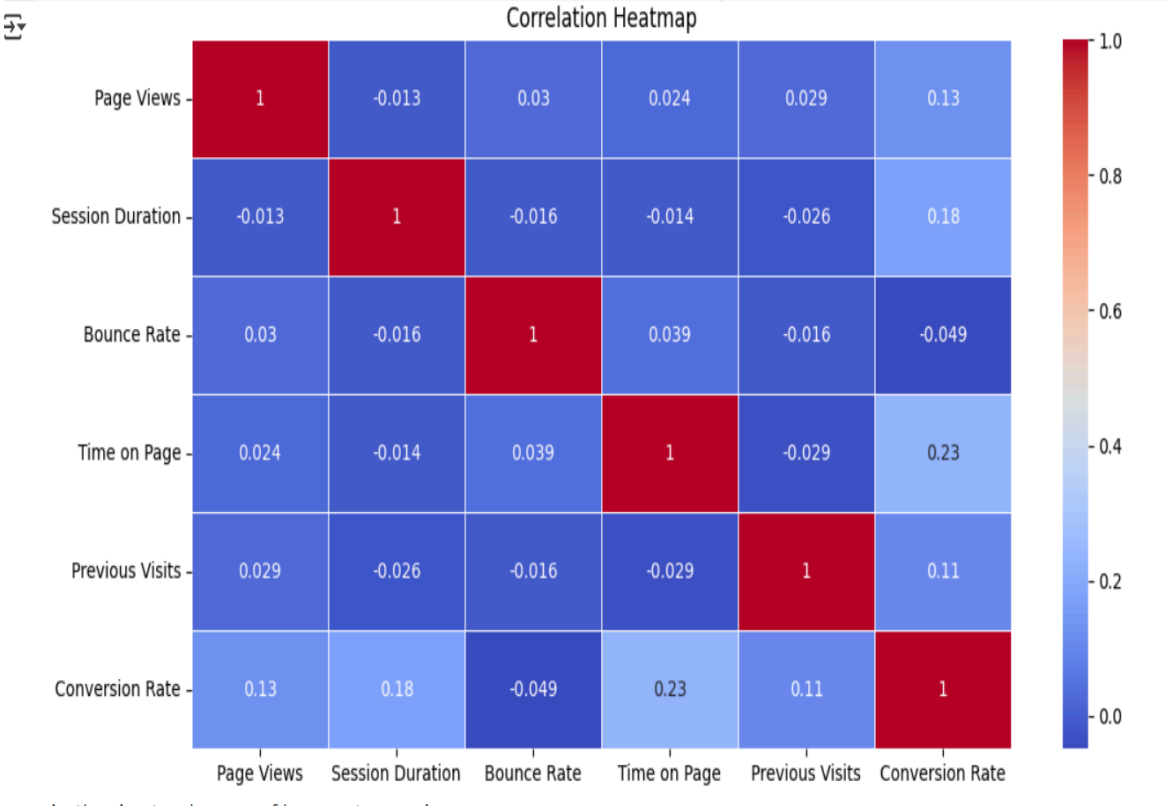
OUTPUT

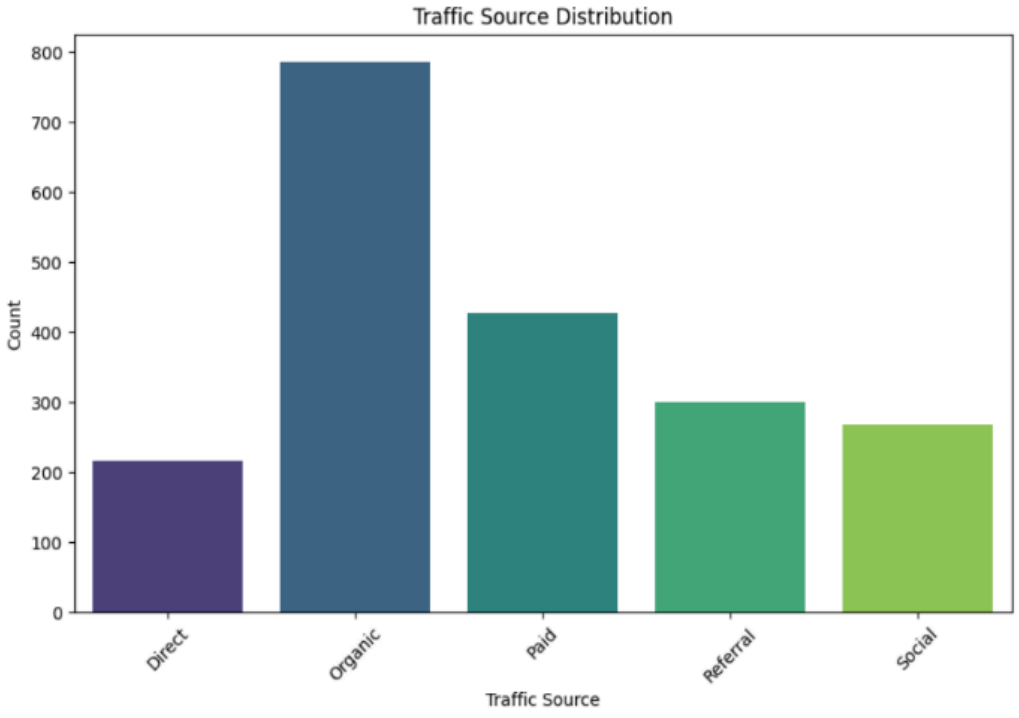
```
Dataset Overview:
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2000 entries, 0 to 1999
Data columns (total 7 columns):
 #   Column            Non-Null Count  Dtype
---  ------            --------------  -----
 0   Page Views        2000 non-null   int64
 1   Session Duration  2000 non-null   float64
 2   Bounce Rate       2000 non-null   float64
 3   Traffic Source    2000 non-null   object
 4   Time on Page      2000 non-null   float64
 5   Previous Visits   2000 non-null   int64
 6   Conversion Rate   2000 non-null   float64
dtypes: float64(4), int64(2), object(1)
memory usage: 109.5+ KB
None
   Page Views  Session Duration  Bounce Rate Traffic Source  Time on Page  \
0           5         11.051381     0.230652        Organic      3.890460
1           4          3.429316     0.391001         Social      8.478174
2           4          1.621052     0.397986        Organic      9.636170
3           5          3.629279     0.180458        Organic      2.071925
4           5          4.235843     0.291541           Paid      1.960654

   Previous Visits  Conversion Rate
0                3              1.0
1                0              1.0
2                2              1.0
3                3              1.0
4                5              1.0

Summary Statistics:
```

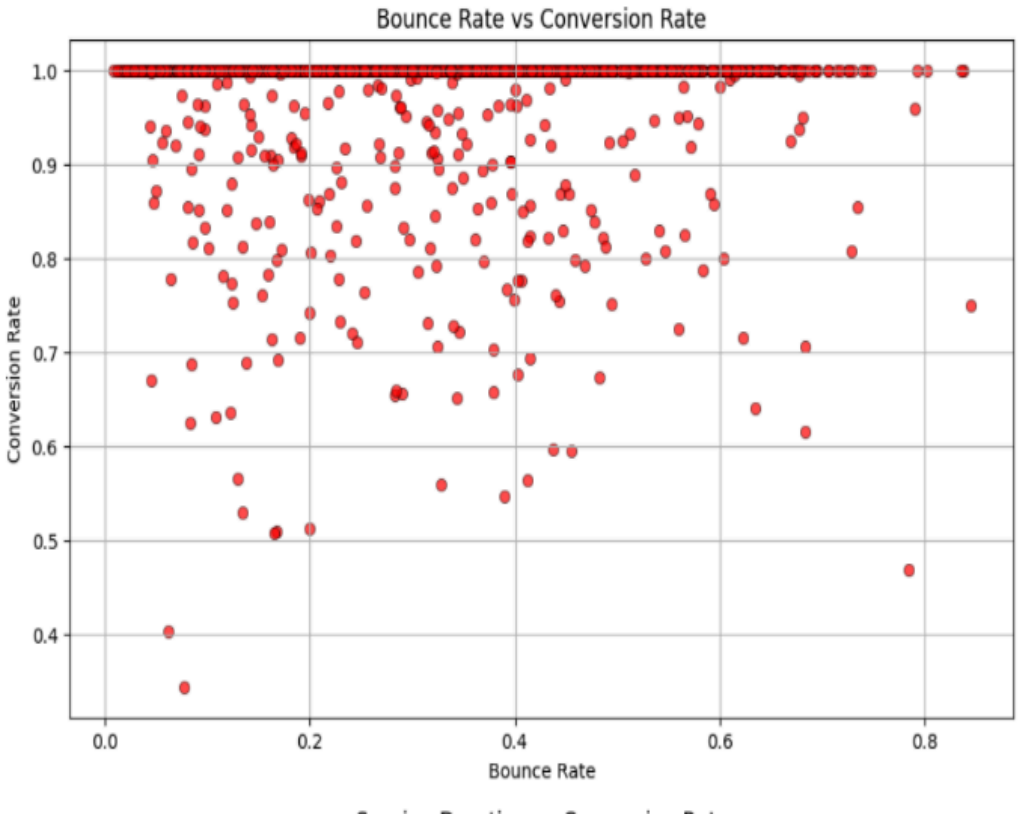
✓ Connected to Python 3 Google Compute Engine backend

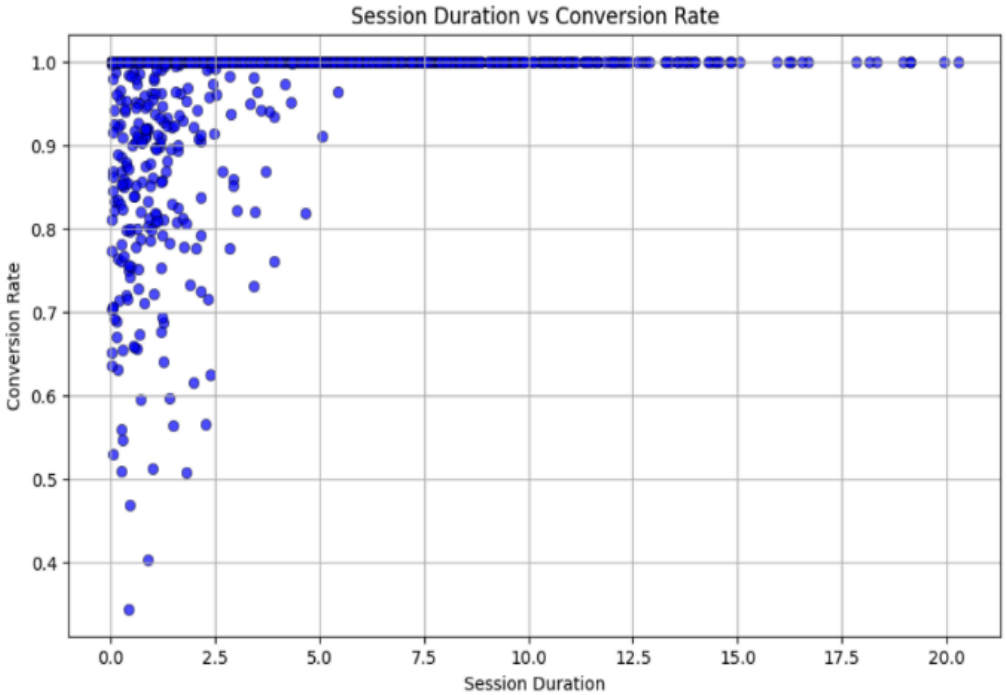
```
Summary Statistics:
        Page Views  Session Duration  Bounce Rate  Time on Page  \
count  2000.000000       2000.000000  2000.000000   2000.000000
mean      4.950500          3.022045     0.284767      4.027439
std       2.183903          3.104518     0.159781      2.887422
min       0.000000          0.003613     0.007868      0.068515
25%       3.000000          0.815828     0.161986      1.935037
50%       5.000000          1.993983     0.266375      3.315316
75%       6.000000          4.197569     0.388551      5.414627
max      14.000000         20.290516     0.844939     24.796182

       Previous Visits  Conversion Rate
count      2000.000000      2000.000000
mean          1.978500         0.982065
std           1.432852         0.065680
min           0.000000         0.343665
25%           1.000000         1.000000
50%           2.000000         1.000000
75%           3.000000         1.000000
max           9.000000         1.000000

Missing Values:
Page Views          0
Session Duration    0
Bounce Rate         0
Traffic Source      0
Time on Page        0
Previous Visits     0
Conversion Rate     0
dtype: int64
```

✓ Connected to Python 3 Google Compute Engine backend

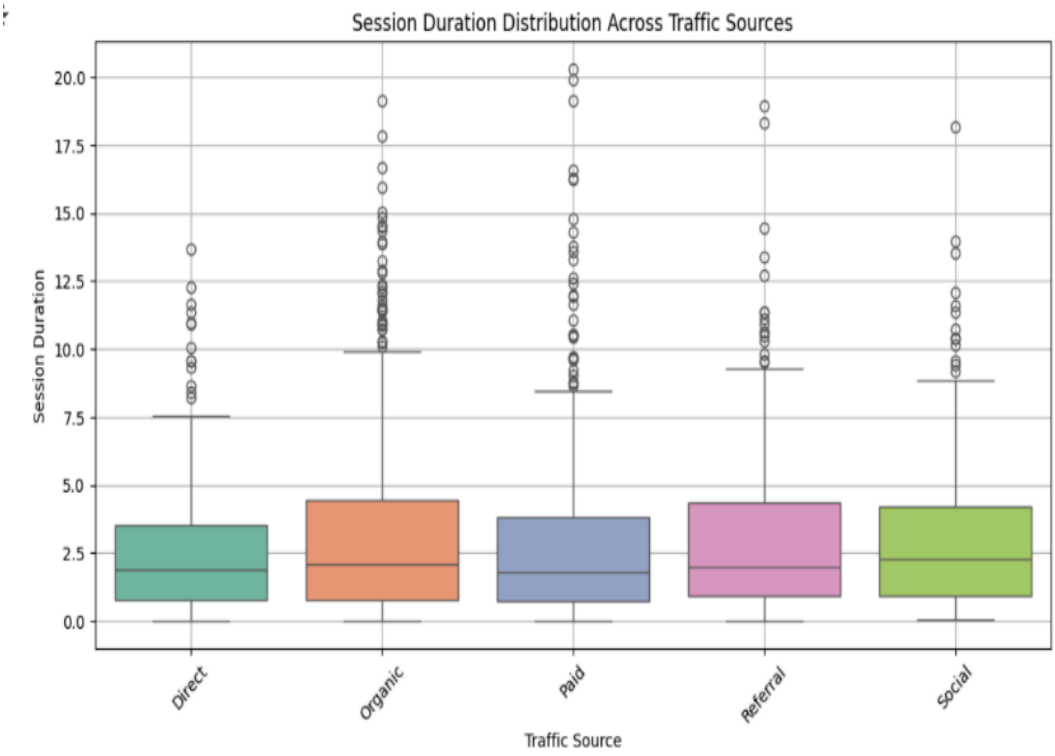

Correlation Heatmap
Page Views
Session Duration
Bounce Rate
Time on Page
Previous Visits
Conversion Rate
1
-0.013
0.03
0.024
0.029
0.13
-0.013
1
-0.016
-0.014
-0.026
0.18
0.03
-0.016
1
0.039
-0.016
-0.049
0.024
-0.014
0.039
1
-0.029
0.23
0.029
-0.026
-0.016
-0.029
1
0.11
0.13
0.18
-0.049
0.23
0.11
1
1.0
0.8
0.6
0.4
0.2
0.0

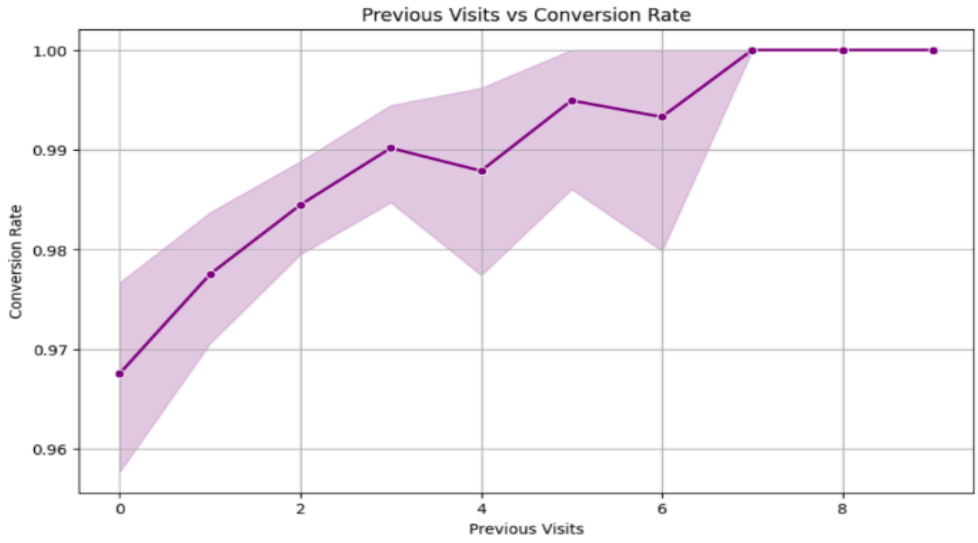

Traffic Source Distribution
Count
800
700
600
500
400
300
200
100
0
Direct
Organic
Paid
Referral
Social
Traffic Source


Bounce Rate vs Conversion Rate
Conversion Rate
Bounce Rate
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.0
0.2
0.4
0.6
0.8


Session Duration vs Conversion Rate
Conversion Rate
Session Duration
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0

Session Duration





The given Python program is an ultimate data analysis and visualization package used to measure the performance of website traffic. Powerful libraries like Pandas, Matplotlib, and Seaborn are used here to import and clean the data and then understand the dataset using exploratory methods. The given dataset contains crucial performance indicators like Page Views, Session Duration, Bounce Rate, Traffic Source, Time on Page, Previous Visits, and Conversion Rate, which hold significant importance while analyzing user interaction and website efficacy.

The analysis starts by presenting the structure and summary statistics of the dataset to provide an initial comprehension of the data. It scans for missing values and transforms categorical variables (such as Traffic Source) into analytical-friendly formats. The code also examines relationships between the variables by both descriptive statistics and visual trends.

A range of sophisticated and visually appealing visualizations are utilized to derive actionable insights:

- **A correlation heatmap** aids in determining strong or weak correlations between quantitative measures like bounce rate and conversion rate.
- **Bar plots and box plots** display traffic sources and their influence on user activity.
- **Scatter plots** emphasize correlations such as Session Duration vs Conversion Rate and Bounce Rate vs Conversion Rate, allowing for easier interpretation of trends and outliers.
- **A line plot** displays the impact of prior visits on conversion rate and reveals a history behavioral trend.
- **Multi-hue scatter plots** (for example, Time on Page against Conversion Rate color-coded by Traffic Source) support a multi-dimensional comparison within a single sight.

All visualizations have been individually selected and formatted for ease of understanding, readability, and aesthetics. Combined, these insights can reveal what areas of user interaction are responsible for the most conversion, which sources of traffic perform better, and how content engagement can be maximized. The total analysis has the capability to aid web analysts, marketers, and product teams with data-driven decision-making and improve the overall performance of a website.

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