Website Performance Analysis – Full Project

THE iSCALE

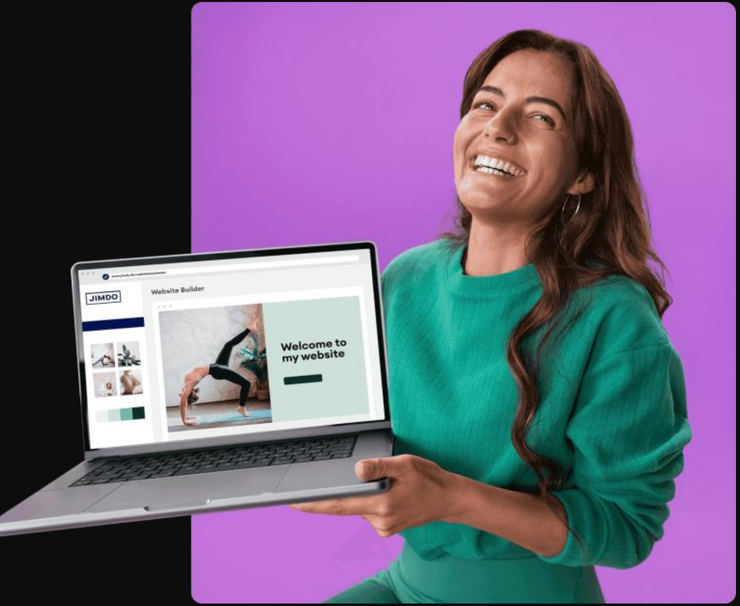
As of 2025, the total number of websites on the internet is estimated to be around 110 to 120 crore

Over 60% of web traffic now comes from mobile devices

THE iSCALE

Website Performance Analysis

Full Project – Data Analysis & Data Science



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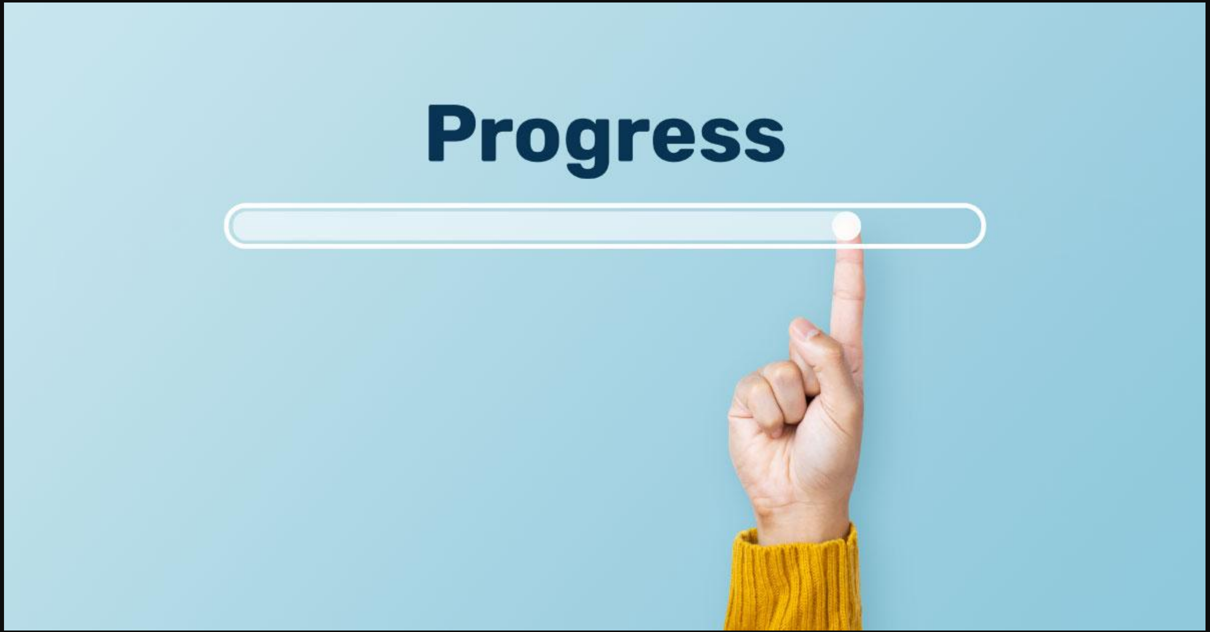
Website Performance Analysis – Full Project

THE I iSCALE



Questions

1) What patterns or trends can you observe in website sessions and users over time?
2) Which marketing channel brought the highest number of users to the website, and how can we use this insight to improve traffic from other sources?
3) Which channel has the highest average engagement time, and what does that tell us about user behavior and content effectiveness?
4) How does engagement rate vary across different traffic channels?
5) Which channels are driving more engaged sessions compared to non-engaged ones, and what strategies can improve engagement in underperforming channels?
6) At what hours of the day does each channel drive the most traffic?
7) Is there any correlation between high traffic (sessions) and high engagement rate over time?

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Siblings - Nishant Dhote & Swati Dhote

In [66]:

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

In [68]:

```
df = pd.read_csv("data-export (1).csv")
```

In [70]:

```
df.head()
```

Out[70]:

	# ------- ---------- ---------- ---------- ---	Unnamed: 1	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	
0	Session primary channel group (Default channel...	Date + hour (YYYYMMDDHH)	Users	Sessions	Engaged sessions	Average engagement time per session	
1	Direct	2024041623	237	300	144	47.526666666666700	0.
2	Organic Social	2024041719	208	267	132	32.09737827715360	0.
3	Direct	2024041723	188	233	115	39.93991416309010	0.
4	Organic Social	2024041718	187	256	125	32.16015625	0.

In [72]:

```
df.columns = df.iloc[0]
df = df.drop(index = 0).reset_index(drop = True)
df.columns = ["channel group", "DateHour", "Users", "Sessions", "Engaged Session
```

In [74]:

```
df.head()
```

Out[74]:

	channel group	DateHour	Users	Sessions	Engaged Sessions	Average engagement time per session	Engaged sess per
0	Direct	2024041623	237	300	144	47.526666666666700	0.607594936708
1	Organic Social	2024041719	208	267	132	32.09737827715360	0.634615384615
2	Direct	2024041723	188	233	115	39.93991416309010	0.611702127659
3	Organic Social	2024041718	187	256	125	32.16015625	0.668449197860
4	Organic Social	2024041720	175	221	112	46.918552036199100	

In [76]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 3182 entries, 0 to 3181
Data columns (total 10 columns):
 #   Column                            Non-Null Count  Dtype 
---  ------                            --------------  ----- 
 0   channel group                     3182 non-null   object
 1   DateHour                          3182 non-null   object
 2   Users                             3182 non-null   object
 3   Sessions                          3182 non-null   object
 4   Engaged Sessions                  3182 non-null   object
 5   Average engagement time per session  3182 non-null   object
 6   Engaged sessions per user         3182 non-null   object
 7   Events per session                3182 non-null   object
 8   Engagement rate                   3182 non-null   object
 9   Event count                       3182 non-null   object
dtypes: object(10)
memory usage: 248.7+ KB
```

cleaning data and data validation for the above data set

In [79]:
```
df.head()
```

Out[79]:

	channel group	DateHour	Users	Sessions	Engaged Sessions	Average engagement time per session	Engaged sess per
0	Direct	2024041623	237	300	144	47.526666666666700	0.607594936708
1	Organic Social	2024041719	208	267	132	32.09737827715360	0.634615384615
2	Direct	2024041723	188	233	115	39.93991416309010	0.611702127659
3	Organic Social	2024041718	187	256	125	32.16015625	0.668449197860
4	Organic Social	2024041720	175	221	112	46.918552036199100	

In [81]:
```
df["DateHour"] = pd.to_datetime(df["DateHour"], format="%Y%m%d%H", errors='coerc
```

In [83]:
```
numeric_cols = df.columns.drop(["channel group", "DateHour"])
df[numeric_cols] = df[numeric_cols].apply(pd.to_numeric, errors='coerce')
df["Hour"] = df["DateHour"].dt.hour
```

In [85]:
```
df.head()
```

Out[85]:

	channel group	DateHour	Users	Sessions	Engaged Sessions	Average engagement time per session	Engaged sessions per user	Events per session	Eng
0	Direct	2024-04-16 23:00:00	237	300	144	47.526667	0.607595	4.673333	
1	Organic Social	2024-04-17 19:00:00	208	267	132	32.097378	0.634615	4.295880	
2	Direct	2024-04-17 23:00:00	188	233	115	39.939914	0.611702	4.587983	
3	Organic Social	2024-04-17 18:00:00	187	256	125	32.160156	0.668449	4.078125	
4	Organic Social	2024-04-17 20:00:00	175	221	112	46.918552	0.640000	4.529412	

In [87]:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 3182 entries, 0 to 3181
Data columns (total 11 columns):
 #   Column                               Non-Null Count  Dtype         
---  ------                               --------------  -----         
 0   channel group                        3182 non-null   object        
 1   DateHour                             3182 non-null   datetime64[ns]
 2   Users                                3182 non-null   int64         
 3   Sessions                             3182 non-null   int64         
 4   Engaged Sessions                     3182 non-null   int64         
 5   Average engagement time per session  3182 non-null   float64       
 6   Engaged sessions per user            3182 non-null   float64       
 7   Events per session                   3182 non-null   float64       
 8   Engagement rate                      3182 non-null   float64       
 9   Event count                          3182 non-null   int64         
 10  Hour                                 3182 non-null   int32         
dtypes: datetime64[ns](1), float64(4), int32(1), int64(4), object(1)
memory usage: 261.2+ KB
```

In [89]:

```
df.describe()
```

Out[89]:

	DateHour	Users	Sessions	Engaged Sessions	Average engagement time per session	Enga sess per
count	3182	3182.000000	3182.000000	3182.000000	3182.000000	3182.00
mean	2024-04-20 01:17:07.278441216	41.935889	51.192646	28.325581	66.644581	0.60
min	2024-04-06 00:00:00	0.000000	1.000000	0.000000	0.000000	0.00
25%	2024-04-13 02:15:00	20.000000	24.000000	13.000000	32.103034	0.56
50%	2024-04-20 02:00:00	42.000000	51.000000	27.000000	49.020202	0.66
75%	2024-04-26 22:00:00	60.000000	71.000000	41.000000	71.487069	0.75
max	2024-05-03 23:00:00	237.000000	300.000000	144.000000	4525.000000	2.00
std	NaN	29.582258	36.919962	20.650569	127.200659	0.26

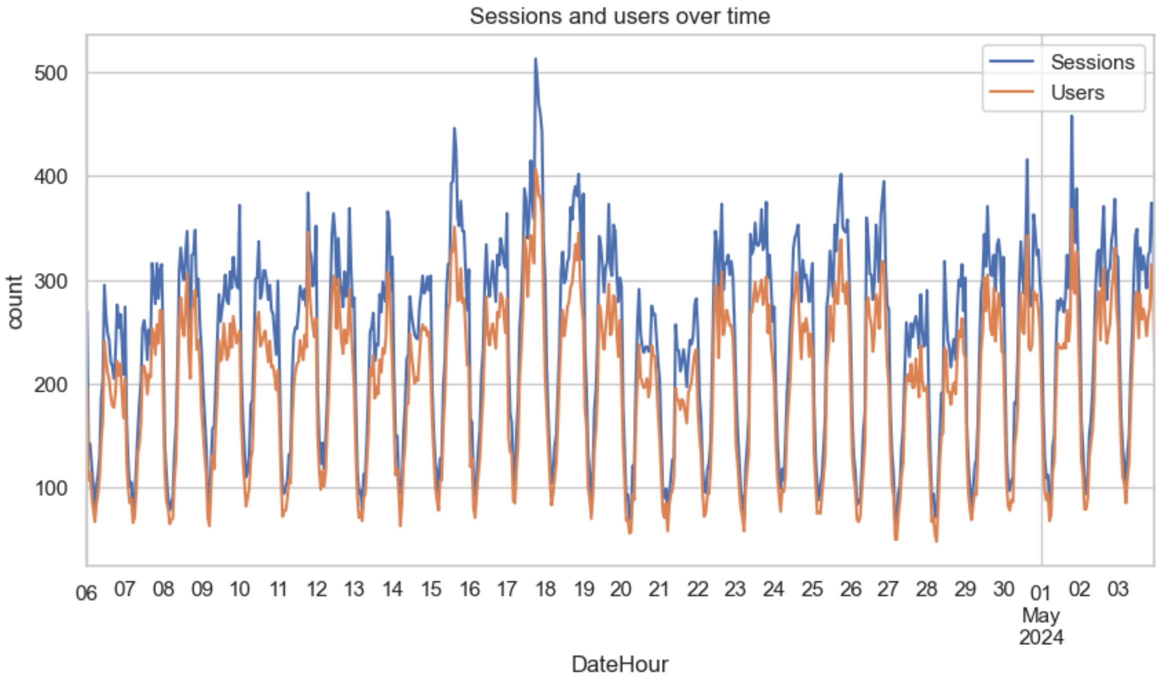
sessions and user over time

In [92]:

```
sns.set(style="whitegrid")
```

In [94]:

```
plt.figure(figsize=(10,5))
df.groupby("DateHour")[["Sessions","Users"]].sum().plot(ax=plt.gca())
plt.title("Sessions and users over time")
plt.xlabel("DateHour")
plt.ylabel("count")
plt.show()
```



total users by channel

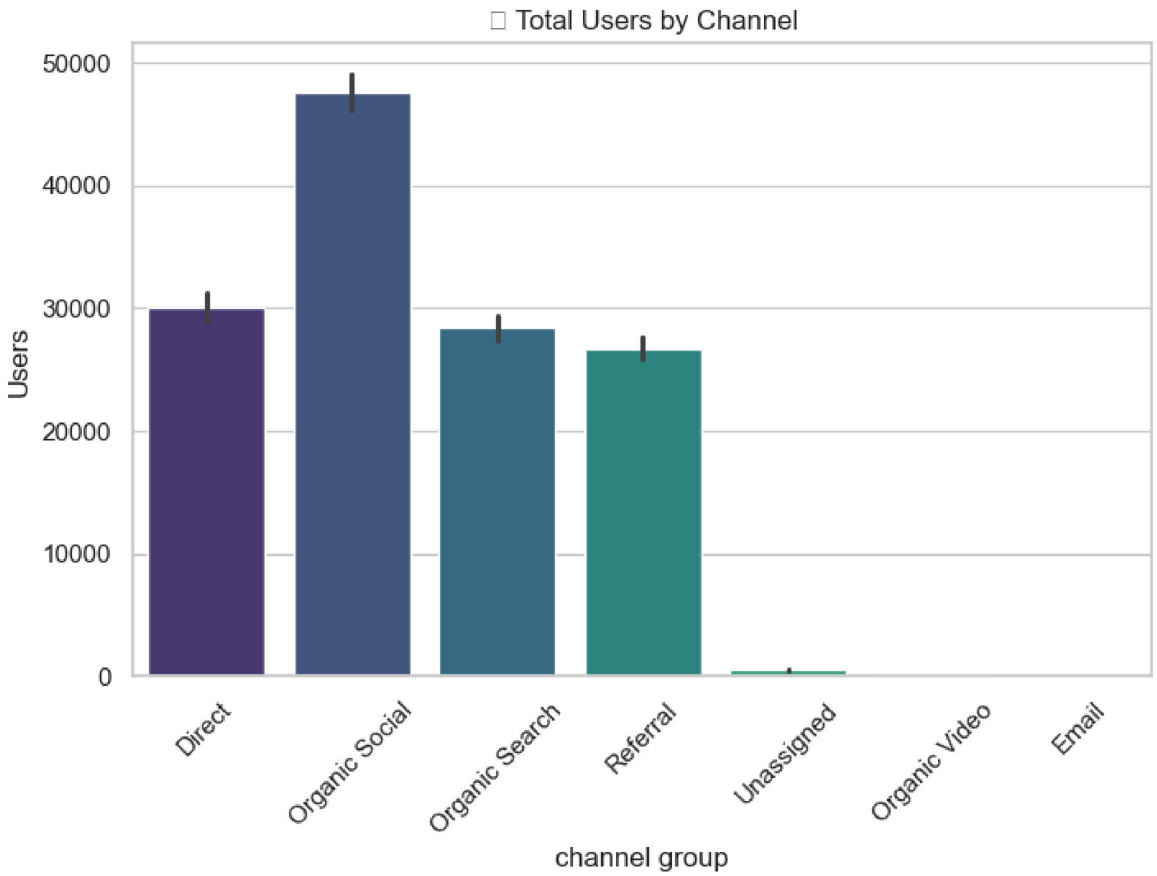
In [96]:

```
plt.figure(figsize=(8, 5))
sns.barplot(data=df, x="channel group", y="Users", estimator=np.sum, palette="vi
plt.title("👥 Total Users by Channel")
plt.xticks(rotation=45)
plt.show()
```

```
C:\Users\swati\AppData\Local\Temp\ipykernel_21616\900529494.py:2: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v
0.14.0. Assign the `x` variable to `hue` and set `legend=False` for the same effe
ct.

  sns.barplot(data=df, x="channel group", y="Users", estimator=np.sum, palette="v
iridis")
C:\Users\swati\anaconda3\Lib\site-packages\IPython\core\pylabtools.py:170: UserWa
rning: Glyph 128101 (\N{BUSTS IN SILHOUETTE}) missing from font(s) Arial.
  fig.canvas.print_figure(bytes_io, **kw)
```



In [97]:

```
df.head()
```

Out[97]:

	channel group	DateHour	Users	Sessions	Engaged Sessions	Average engagement time per session	Engaged sessions per user	Events per session	Eng
0	Direct	2024-04-16 23:00:00	237	300	144	47.526667	0.607595	4.673333	
1	Organic Social	2024-04-17 19:00:00	208	267	132	32.097378	0.634615	4.295880	
2	Direct	2024-04-17 23:00:00	188	233	115	39.939914	0.611702	4.587983	
3	Organic Social	2024-04-17 18:00:00	187	256	125	32.160156	0.668449	4.078125	
4	Organic Social	2024-04-17 20:00:00	175	221	112	46.918552	0.640000	4.529412	

Average engagement time by channel

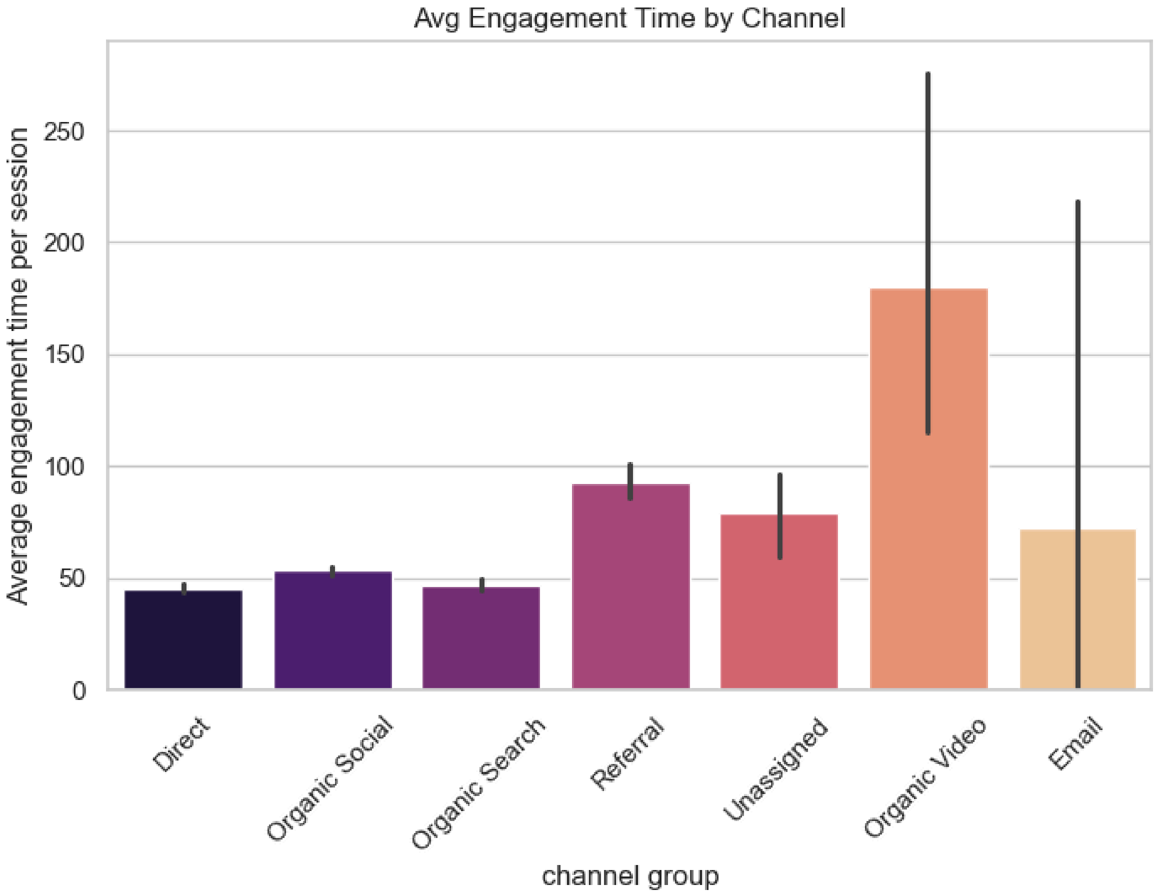
In [100…

```
plt.figure(figsize=(8, 5))
sns.barplot(data=df, x="channel group", y="Average engagement time per session",
plt.title("Avg Engagement Time by Channel")
plt.xticks(rotation=45)
plt.show()
```

```
C:\Users\swati\AppData\Local\Temp\ipykernel_21616\523820305.py:2: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v
0.14.0. Assign the `x` variable to `hue` and set `legend=False` for the same effe
ct.

  sns.barplot(data=df, x="channel group", y="Average engagement time per sessio
n", estimator=np.mean, palette="magma")
```



In [107…

```
df.head()
```

Out[107…

	channel group	DateHour	Users	Sessions	Engaged Sessions	Average engagement time per session	Engaged sessions per user	Events per session	Eng
0	Direct	2024-04-16 23:00:00	237	300	144	47.526667	0.607595	4.673333	
1	Organic Social	2024-04-17 19:00:00	208	267	132	32.097378	0.634615	4.295880	
2	Direct	2024-04-17 23:00:00	188	233	115	39.939914	0.611702	4.587983	
3	Organic Social	2024-04-17 18:00:00	187	256	125	32.160156	0.668449	4.078125	
4	Organic Social	2024-04-17 20:00:00	175	221	112	46.918552	0.640000	4.529412	

Engagement Rate Distribution by channel

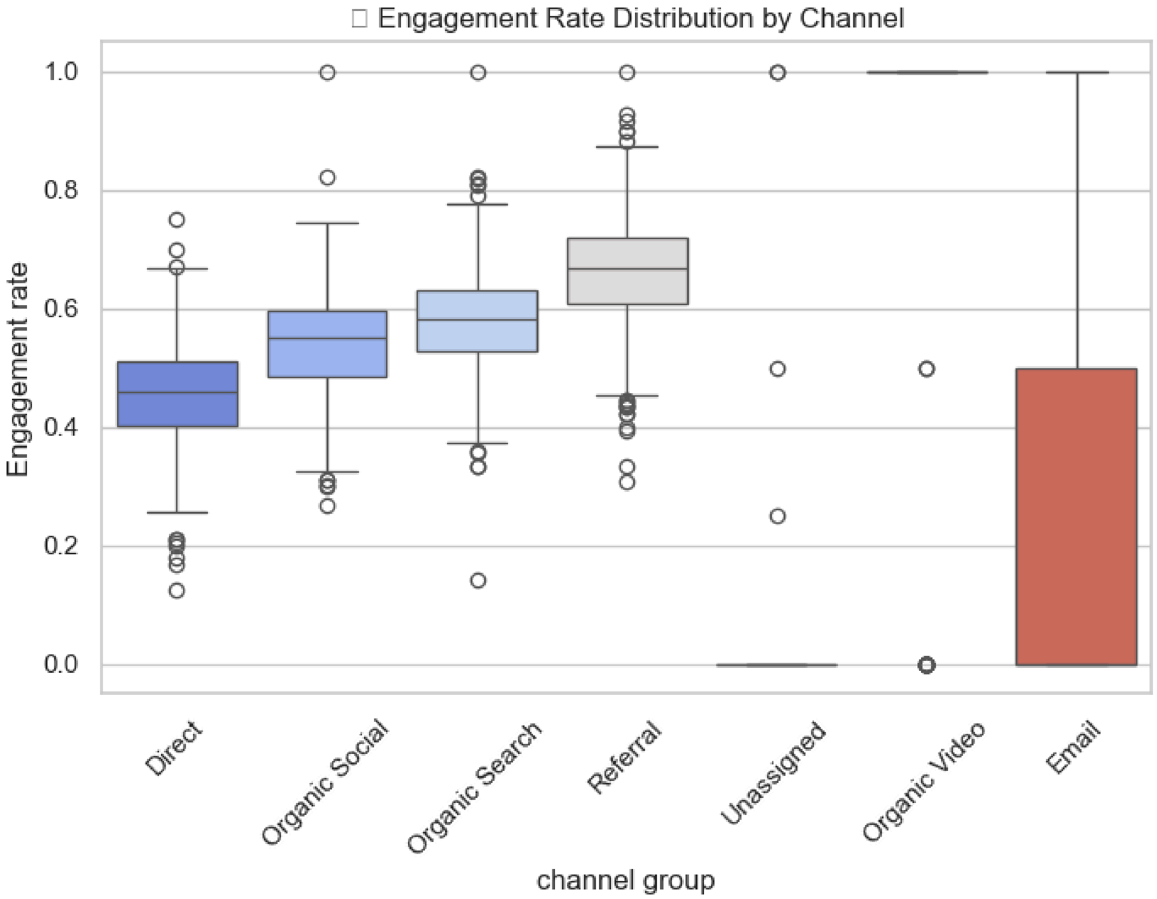
In [112…

```python
plt.figure(figsize=(8, 5))
sns.boxplot(data=df, x="channel group", y="Engagement rate", palette="coolwarm")
plt.title("📦 Engagement Rate Distribution by Channel")
plt.xticks(rotation=45)
plt.show()
```

```
C:\Users\swati\AppData\Local\Temp\ipykernel_21616\2490929186.py:2: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v
0.14.0. Assign the `x` variable to `hue` and set `legend=False` for the same effe
ct.

  sns.boxplot(data=df, x="channel group", y="Engagement rate", palette="coolwar
m")
C:\Users\swati\anaconda3\Lib\site-packages\IPython\core\pylabtools.py:170: UserWa
rning: Glyph 128230 (\N{PACKAGE}) missing from font(s) Arial.
  fig.canvas.print_figure(bytes_io, **kw)
```



Engaged vs non engaged sessions

In [116…

```
df.head()
```

Out[116…

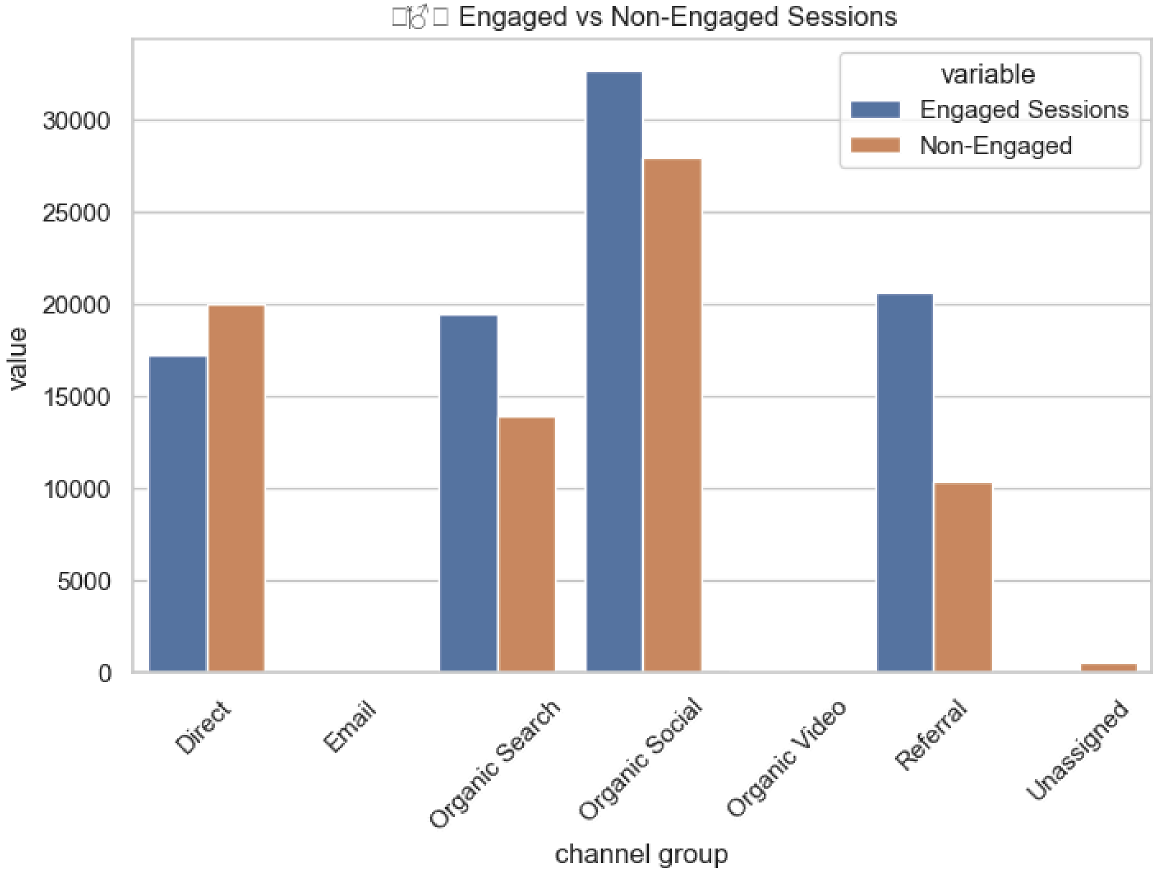
	channel group	DateHour	Users	Sessions	Engaged Sessions	Average engagement time per session	Engaged sessions per user	Events per session	Eng
0	Direct	2024-04-16 23:00:00	237	300	144	47.526667	0.607595	4.673333	
1	Organic Social	2024-04-17 19:00:00	208	267	132	32.097378	0.634615	4.295880	
2	Direct	2024-04-17 23:00:00	188	233	115	39.939914	0.611702	4.587983	
3	Organic Social	2024-04-17 18:00:00	187	256	125	32.160156	0.668449	4.078125	
4	Organic Social	2024-04-17 20:00:00	175	221	112	46.918552	0.640000	4.529412	

In [124…

```
session_df = df.groupby("channel group")[["Sessions", "Engaged Sessions"]].sum()
session_df["Non-Engaged"] = session_df["Sessions"] - session_df["Engaged Session
session_df_melted = session_df.melt(id_vars="channel group", value_vars=["Engage

plt.figure(figsize=(8, 5))
sns.barplot(data=session_df_melted, x="channel group", y="value", hue="variable"
plt.title("🧍‍♂️ Engaged vs Non-Engaged Sessions")
plt.xticks(rotation=45)
plt.show()
```

```
C:\Users\swati\anaconda3\Lib\site-packages\IPython\core\pylabtools.py:170: UserWa
rning: Glyph 129485 (\N{STANDING PERSON}) missing from font(s) Arial.
  fig.canvas.print_figure(bytes_io, **kw)
C:\Users\swati\anaconda3\Lib\site-packages\IPython\core\pylabtools.py:170: UserWa
rning: Glyph 65039 (\N{VARIATION SELECTOR-16}) missing from font(s) Arial.
  fig.canvas.print_figure(bytes_io, **kw)
```



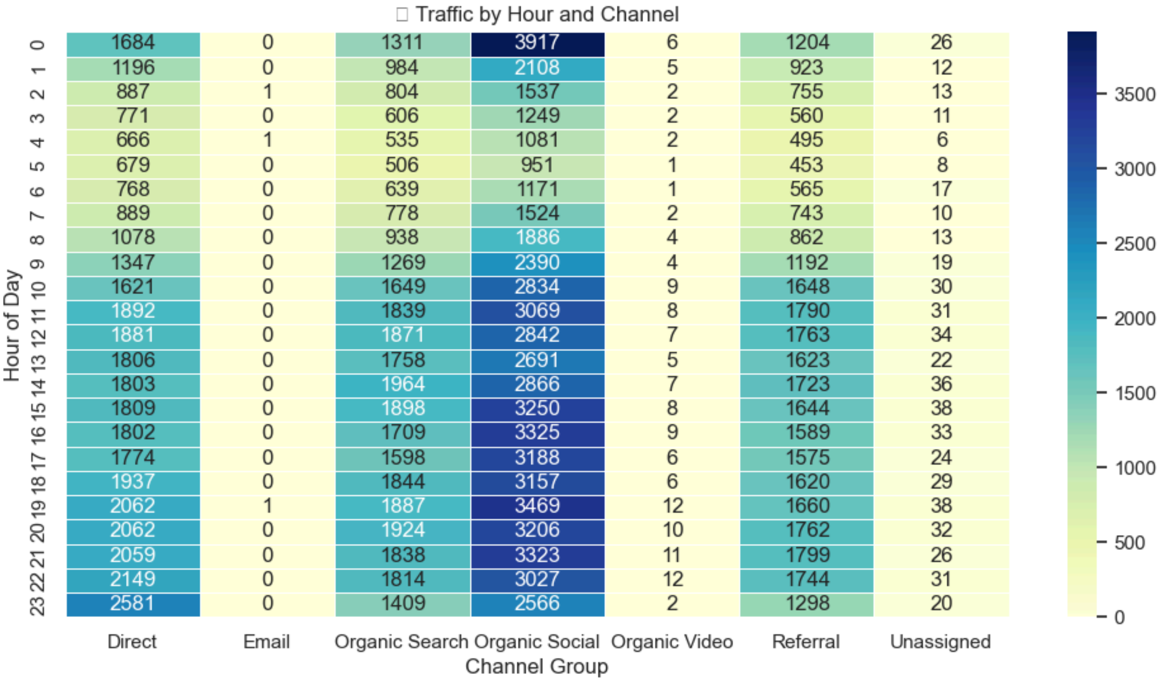
traffic by hour and channel

In [130…

```
heatmap_data = df.groupby(["Hour", "channel group"])["Sessions"].sum().unstack()

plt.figure(figsize=(12, 6))
sns.heatmap(heatmap_data, cmap="YlGnBu", linewidths=.5, annot=True, fmt='.0f')
plt.title("⏰ Traffic by Hour and Channel")
plt.xlabel("Channel Group")
plt.ylabel("Hour of Day")
plt.show()
```

```
C:\Users\swati\anaconda3\Lib\site-packages\IPython\core\pylabtools.py:170: UserWa
rning: Glyph 9200 (\N{ALARM CLOCK}) missing from font(s) Arial.
  fig.canvas.print_figure(bytes_io, **kw)
```



Hour of Day	Direct	Email	Organic Search	Organic Social	Organic Video	Referral	Unassigned
0	1684	0	1311	3917	6	1204	26
1	1196	0	984	2108	5	923	12
2	887	1	804	1537	2	755	13
3	771	0	606	1249	2	560	11
4	666	1	535	1081	2	495	6
5	679	0	506	951	1	453	8
6	768	0	639	1171	1	565	17
7	889	0	778	1524	2	743	10
8	1078	0	938	1886	4	862	13
9	1347	0	1269	2390	4	1192	19
10	1621	0	1649	2834	9	1648	30
11	1892	0	1839	3069	8	1790	31
12	1881	0	1871	2842	7	1763	34
13	1806	0	1758	2691	5	1623	22
14	1803	0	1964	2866	7	1723	36
15	1809	0	1898	3250	8	1644	38
16	1802	0	1709	3325	9	1589	33
17	1774	0	1598	3188	6	1575	24
18	1937	0	1844	3157	6	1620	29
19	2062	1	1887	3469	12	1660	38
20	2062	0	1924	3206	10	1762	32
21	2059	0	1838	3323	11	1799	26
22	2149	0	1814	3027	12	1744	31
23	2581	0	1409	2566	2	1298	20

engagement rate vs sessions over time

In [133…

```
df.head()
```

Out[133…

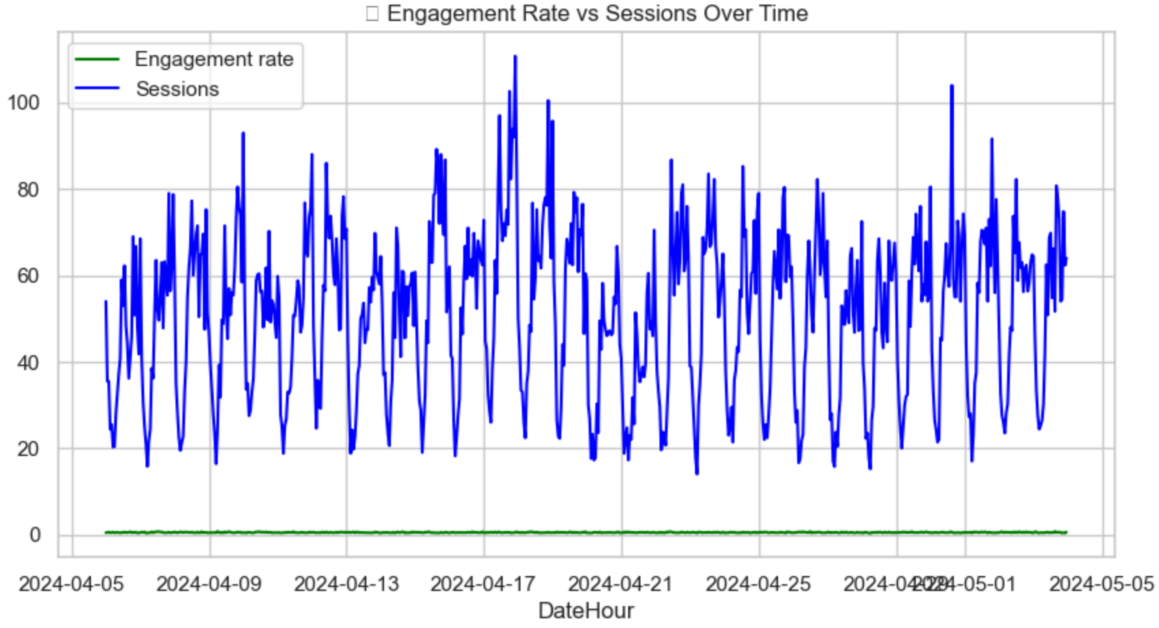
	channel group	DateHour	Users	Sessions	Engaged Sessions	Average engagement time per session	Engaged sessions per user	Events per session	Eng
0	Direct	2024-04-16 23:00:00	237	300	144	47.526667	0.607595	4.673333	
1	Organic Social	2024-04-17 19:00:00	208	267	132	32.097378	0.634615	4.295880	
2	Direct	2024-04-17 23:00:00	188	233	115	39.939914	0.611702	4.587983	
3	Organic Social	2024-04-17 18:00:00	187	256	125	32.160156	0.668449	4.078125	
4	Organic Social	2024-04-17 20:00:00	175	221	112	46.918552	0.640000	4.529412	

In [137…

```
df_plot = df.groupby("DateHour")[["Engagement rate", "Sessions"]].mean().reset_i

plt.figure(figsize=(10, 5))
plt.plot(df_plot["DateHour"], df_plot["Engagement rate"], label="Engagement rate
plt.plot(df_plot["DateHour"], df_plot["Sessions"], label="Sessions", color="blue
plt.title("📊 Engagement Rate vs Sessions Over Time")
plt.xlabel("DateHour")
plt.legend()
plt.grid(True)
plt.show()
```

```
C:\Users\swati\anaconda3\Lib\site-packages\IPython\core\pylabtools.py:170: UserWa
rning: Glyph 128202 (\N{BAR CHART}) missing from font(s) Arial.
  fig.canvas.print_figure(bytes_io, **kw)
```



In [ ]: