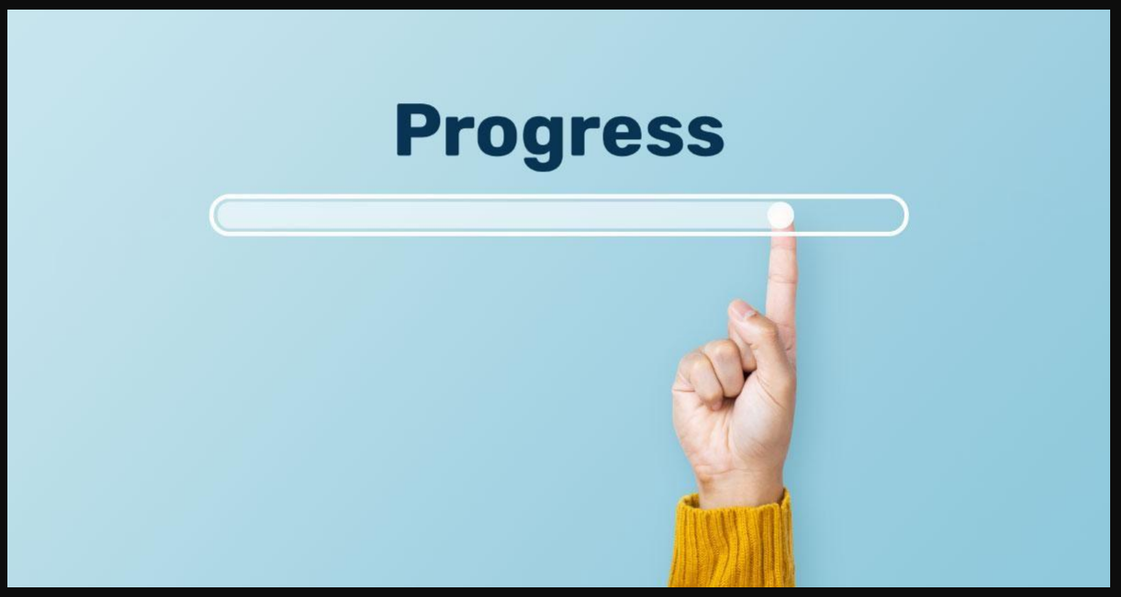
# Website Performance Analysis – Full Project

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

# Website Performance Analysis – Full Project



# 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?

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 
---  ------                                --------------  ----- 
 1   channel group                         3182 non-null   object
 2   DateHour                              3182 non-null   object
 3   Users                                 3182 non-null   object
 4   Sessions                              3182 non-null   object
 5   Engaged Sessions                      3182 non-null   object
 6   Average engagement time per session   3182 non-null   object
 7   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 | |

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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
---  ------                                --------------  -----
 1   channel group                         3182 non-null   object
 2   DateHour                              3182 non-null   datetime64[ns]
 3   Users                                 3182 non-null   int64
 4   Sessions                              3182 non-null   int64
 5   Engaged Sessions                      3182 non-null   int64
 6   Average engagement time per session   3182 non-null   float64
 7   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 | Engaged sessions 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 |

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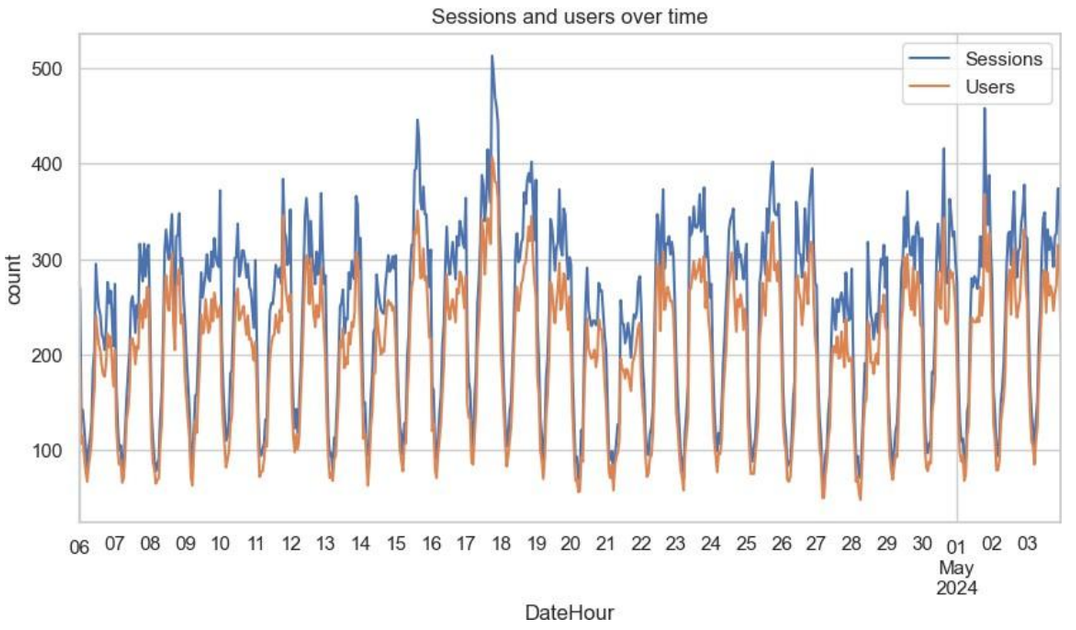
# sessions and user over time

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()
```



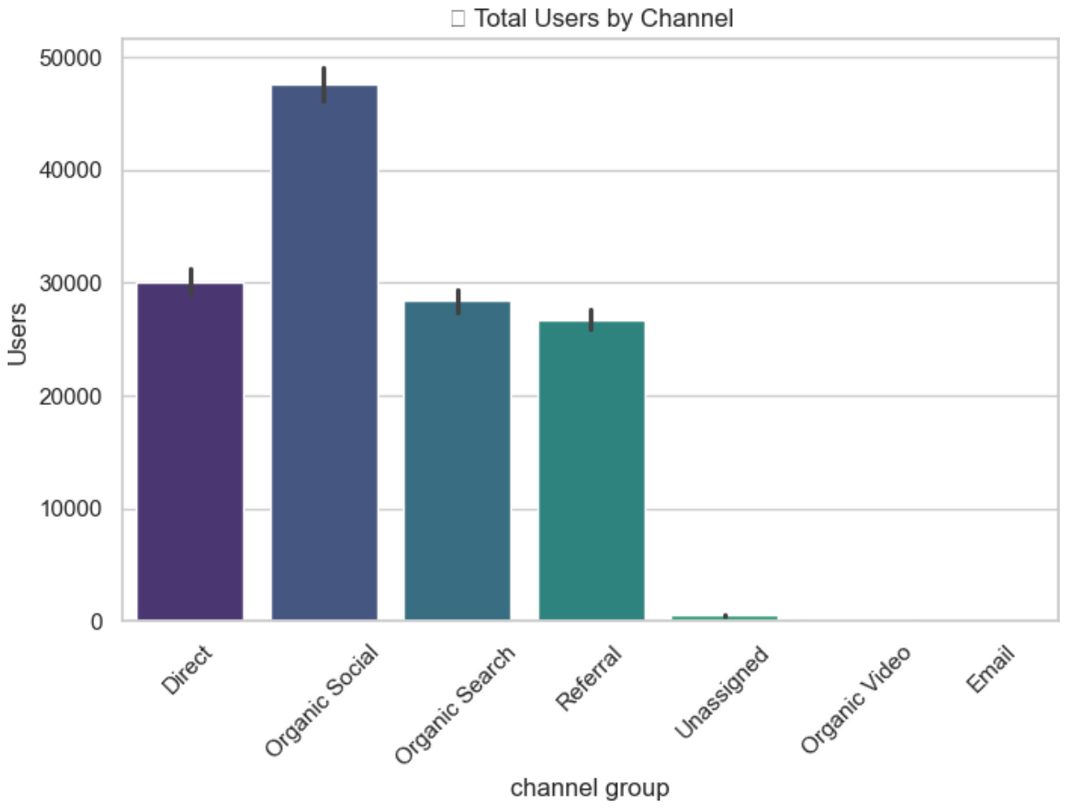

# total users by channel

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
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 | |

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# Average engagement time by channel

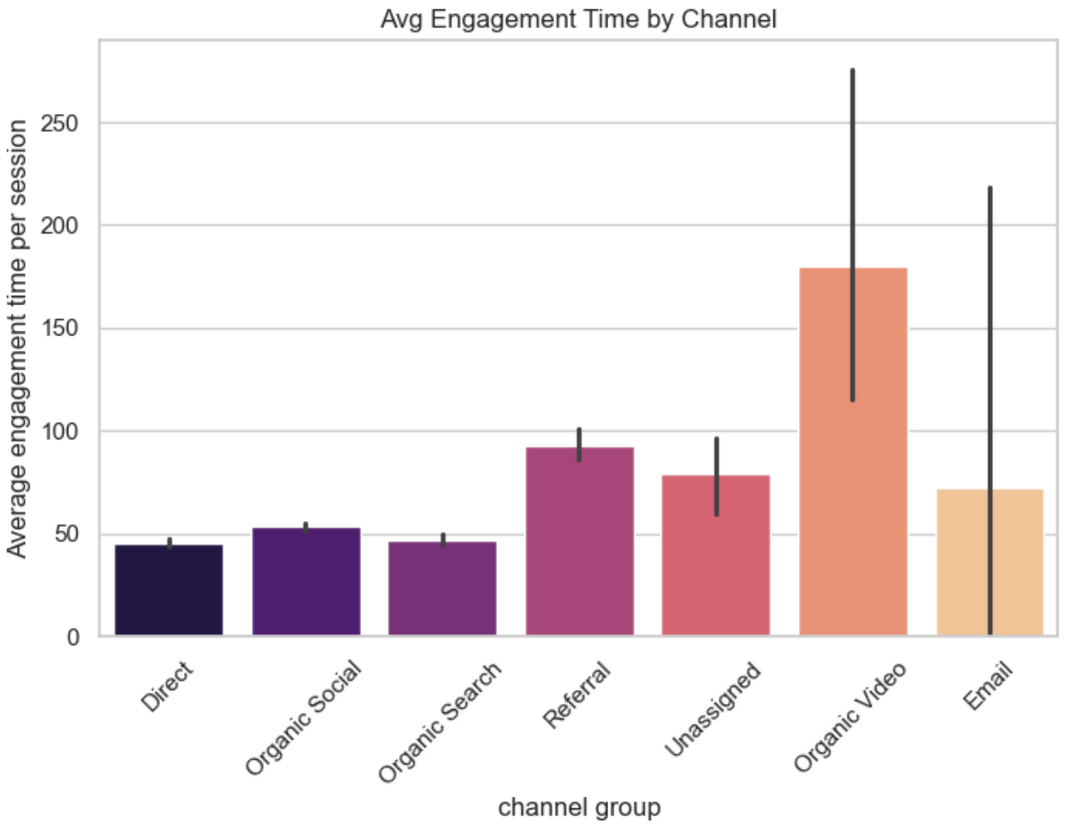
In [100…

```
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 | |

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# Engagement Rate Distribution by channel

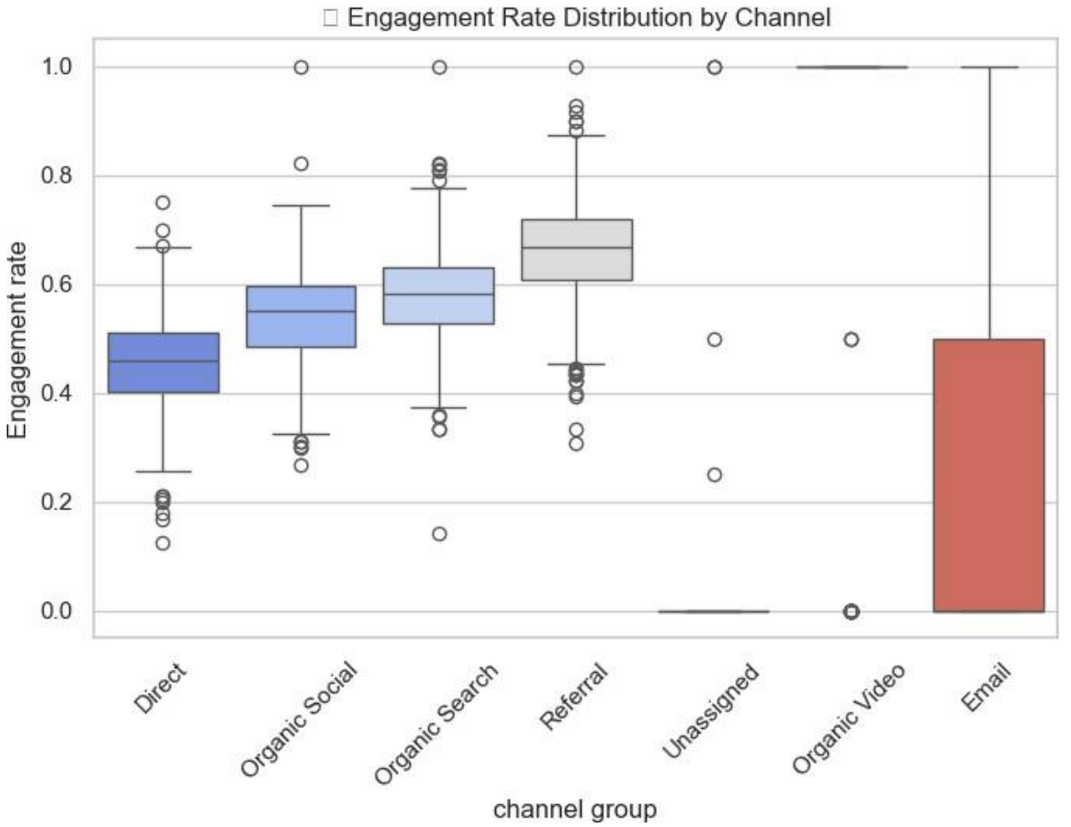
In [112…

```
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 | |

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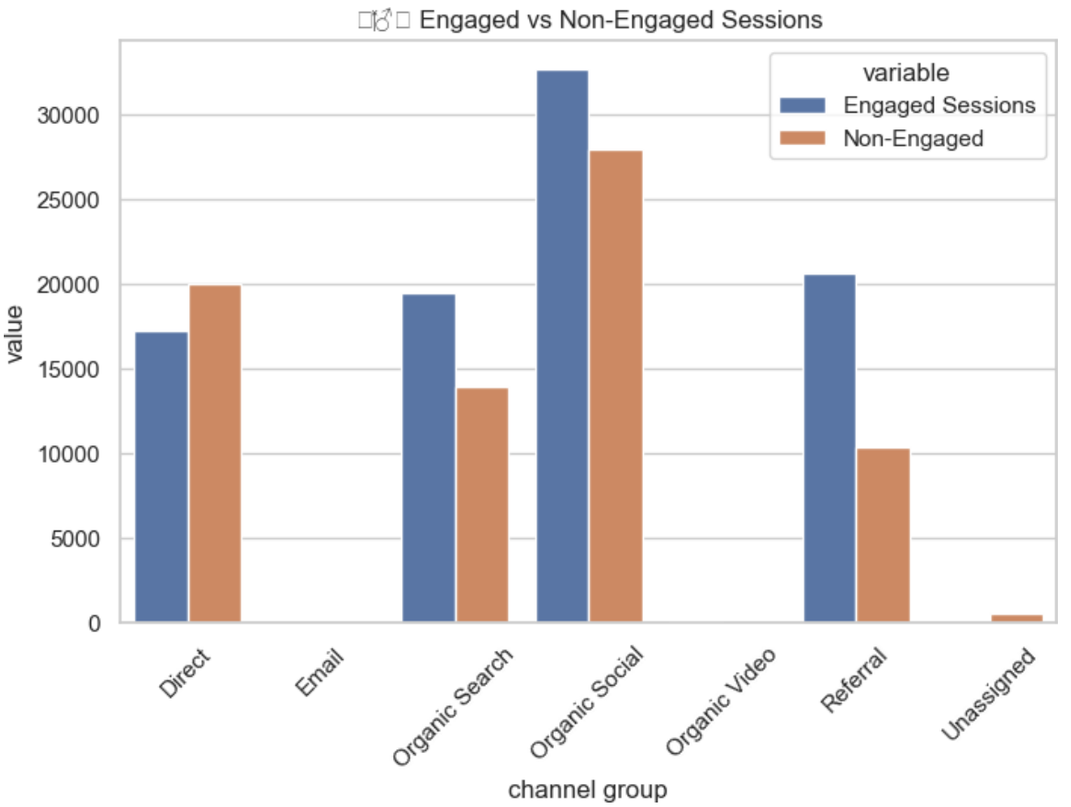
In [124…
```
session_df = df.groupby("channel group")[["Sessions", "Engaged Sessions"]].sum()
session_df["Non-Engaged"] = session_df["Sessions"] - session_df["Engaged Session
session_df_melted = session_df.melt(id_vars="channel group", value_vars=["Engage

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)
```

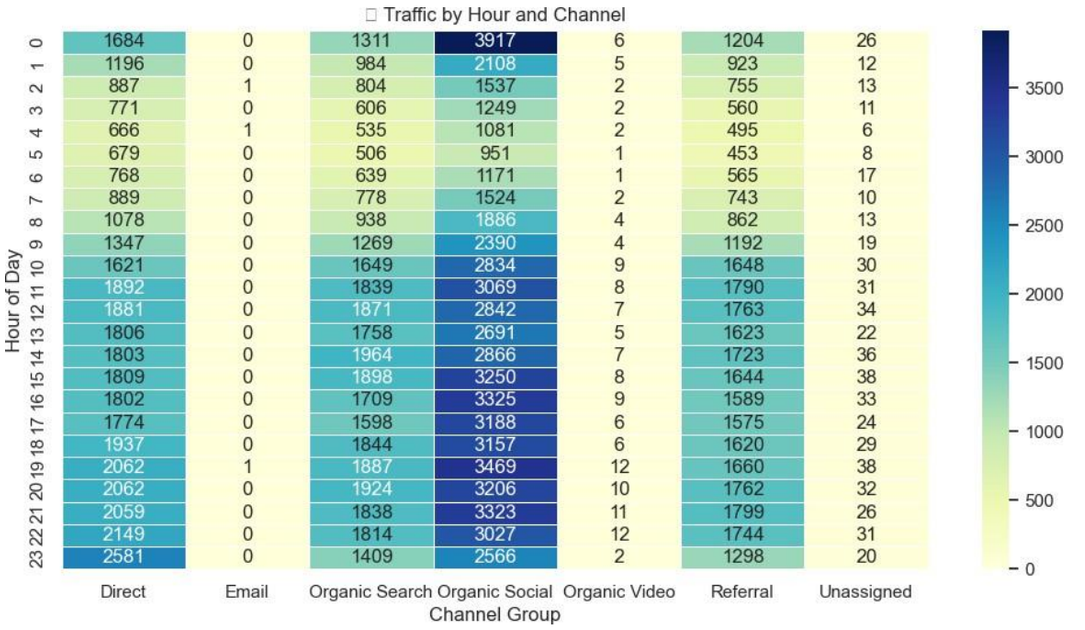



# traffic by hour and channel

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)
```




# 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 | |

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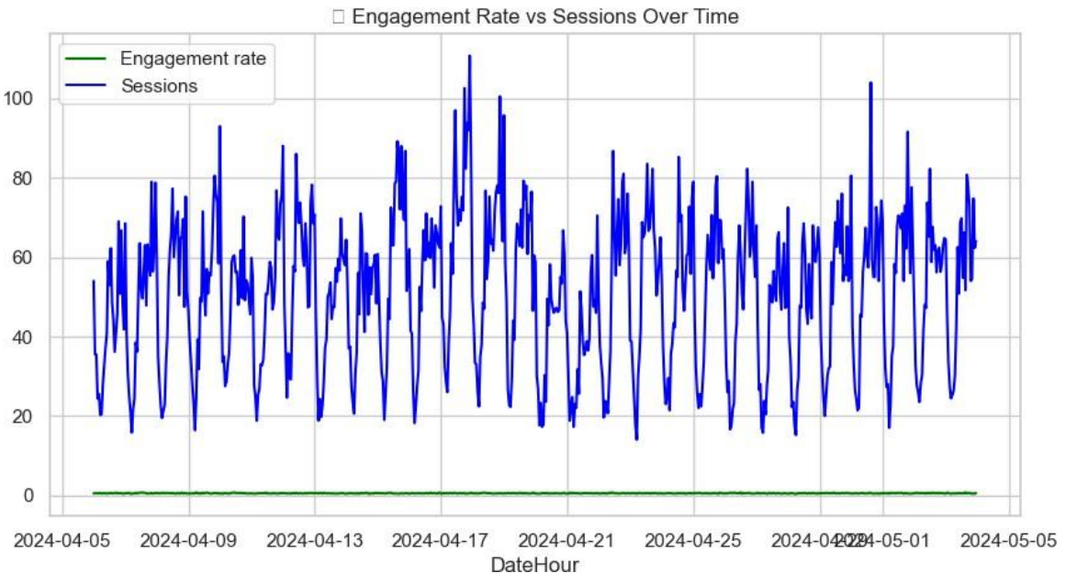
In [137…
```
df_plot = df.groupby("DateHour")[["Engagement rate", "Sessions"]].mean().reset_i

plt.figure(figsize=(10, 5))
plt.plot(df_plot["DateHour"], df_plot["Engagement rate"], label="Engagement rate
plt.plot(df_p 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 [ ]: