

Business Problem

As a marketing agency, our primary object is to maximize the return on investment (ROI) for our clients' advertising campaigns. We have conducted two ad campaigns, one on Facebook and other on AdWords, and we need to determine which platform yields better results in terms of clicks, conversions, and overall cost-effectiveness. By identifying the most effective platform, we can allocate our resources more efficiently and optimize our strategies to deliver better outcomes for our clients.

Research Question


Which ad platform is more effective in terms of conversions, clicks, and overall cost-effective?

```
In [1]: import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

```
In [2]: df = pd.read_csv(r"D:\datasets\Facebook vs Adwards ad dataset.csv")
df.head()
```

Out[2]:

	Date	Facebook Ad Campaign	Facebook Ad Views	Facebook Ad Clicks	Facebook Ad Conversions	Cost per Facebook Ad	Facebook Click- Through Rate (Clicks / View)	Fac Conv (Conve /
0	1/1/2023	FB_Jan	2116	18	8	\$126	0.83%	
1	1/2/2023	FB_Jan	3106	36	12	\$104	1.15%	
2	1/3/2023	FB_Jan	3105	26	8	\$102	0.84%	
3	1/4/2023	FB_Jan	1107	27	9	\$71	2.45%	
4	1/5/2023	FB_Jan	1317	15	7	\$78	1.10%	



```
In [3]: df.shape
```

Out[3]: (365, 17)

```
In [4]: df.dtypes
```

```
Out[4]: Date                                object
        Facebook Ad Campaign                object
        Facebook Ad Views                  int64
        Facebook Ad Clicks                 int64
        Facebook Ad Conversions            int64
        Cost per Facebook Ad               object
        Facebook Click-Through Rate (Clicks / View) object
        Facebook Conversion Rate (Conversions / Clicks) object
        Facebook Cost per Click (Ad Cost / Clicks) object
        AdWords Ad Campaign               object
        AdWords Ad Views                  int64
        AdWords Ad Clicks                 int64
        AdWords Ad Conversions            int64
        Cost per AdWords Ad               object
        AdWords Click-Through Rate (Clicks / View) object
        AdWords Conversion Rate (Conversions / Click) object
        AdWords Cost per Click (Ad Cost / Clicks) object
        dtype: object
```

```
In [5]: #converting date from object to datetime--
        df['Date'] = pd.to_datetime(df['Date'])
```

```
In [6]: df.dtypes
```

```
Out[6]: Date                                datetime64[ns]
        Facebook Ad Campaign                object
        Facebook Ad Views                  int64
        Facebook Ad Clicks                 int64
        Facebook Ad Conversions            int64
        Cost per Facebook Ad               object
        Facebook Click-Through Rate (Clicks / View) object
        Facebook Conversion Rate (Conversions / Clicks) object
        Facebook Cost per Click (Ad Cost / Clicks) object
        AdWords Ad Campaign               object
        AdWords Ad Views                  int64
        AdWords Ad Clicks                 int64
        AdWords Ad Conversions            int64
        Cost per AdWords Ad               object
        AdWords Click-Through Rate (Clicks / View) object
        AdWords Conversion Rate (Conversions / Click) object
        AdWords Cost per Click (Ad Cost / Clicks) object
        dtype: object
```

```
In [7]: df.describe()
```

Out[7]:

	Date	Facebook Ad Views	Facebook Ad Clicks	Facebook Ad Conversions	AdWords Ad Views	AdWords Ad Clicks	AdWords Conversions
count	365	365.000000	365.000000	365.000000	365.000000	365.000000	365.000000
mean	2023-07-02 00:00:00	2179.687671	44.049315	11.742466	4717.19726	60.383562	5.980000
min	2023-01-01 00:00:00	1050.000000	15.000000	5.000000	3714.000000	31.000000	3.000000
25%	2023-04-02 00:00:00	1656.000000	35.000000	10.000000	4247.000000	49.000000	5.000000
50%	2023-07-02 00:00:00	2202.000000	43.000000	12.000000	4711.000000	60.000000	6.000000
75%	2023-10-01 00:00:00	2717.000000	54.000000	13.000000	5190.000000	73.000000	7.000000
max	2023-12-31 00:00:00	3320.000000	73.000000	19.000000	5760.000000	89.000000	9.000000
std	NaN	618.074639	12.140559	2.924786	561.11406	14.368225	1.628000

From this statistical description we can see from the mean that Adwards has more views and clicks compared to the Facebook but the important one is conversion. Where we can see Facebook's conversion average is higher though it has low views and clicks.

In [8]: `df.info()`

```

<class 'pandas.core.frame.DataFrame'>
RangeIndex: 365 entries, 0 to 364
Data columns (total 17 columns):
 #   Column                                     Non-Null Count  Dtype
---  -
 0   Date                                     365 non-null    datetime64
[ns]
 1   Facebook Ad Campaign                   365 non-null    object
 2   Facebook Ad Views                     365 non-null    int64
 3   Facebook Ad Clicks                    365 non-null    int64
 4   Facebook Ad Conversions                365 non-null    int64
 5   Cost per Facebook Ad                   365 non-null    object
 6   Facebook Click-Through Rate (Clicks / View) 365 non-null    object
 7   Facebook Conversion Rate (Conversions / Clicks) 365 non-null    object
 8   Facebook Cost per Click (Ad Cost / Clicks) 365 non-null    object
 9   AdWords Ad Campaign                   365 non-null    object
10   AdWords Ad Views                     365 non-null    int64
11   AdWords Ad Clicks                    365 non-null    int64
12   AdWords Ad Conversions                365 non-null    int64
13   Cost per AdWords Ad                   365 non-null    object
14   AdWords Click-Through Rate (Clicks / View) 365 non-null    object
15   AdWords Conversion Rate (Conversions / Click) 365 non-null    object
16   AdWords Cost per Click (Ad Cost / Clicks) 365 non-null    object
dtypes: datetime64[ns](1), int64(6), object(10)
memory usage: 48.6+ KB

```

All 365 values.....Means no null value present.

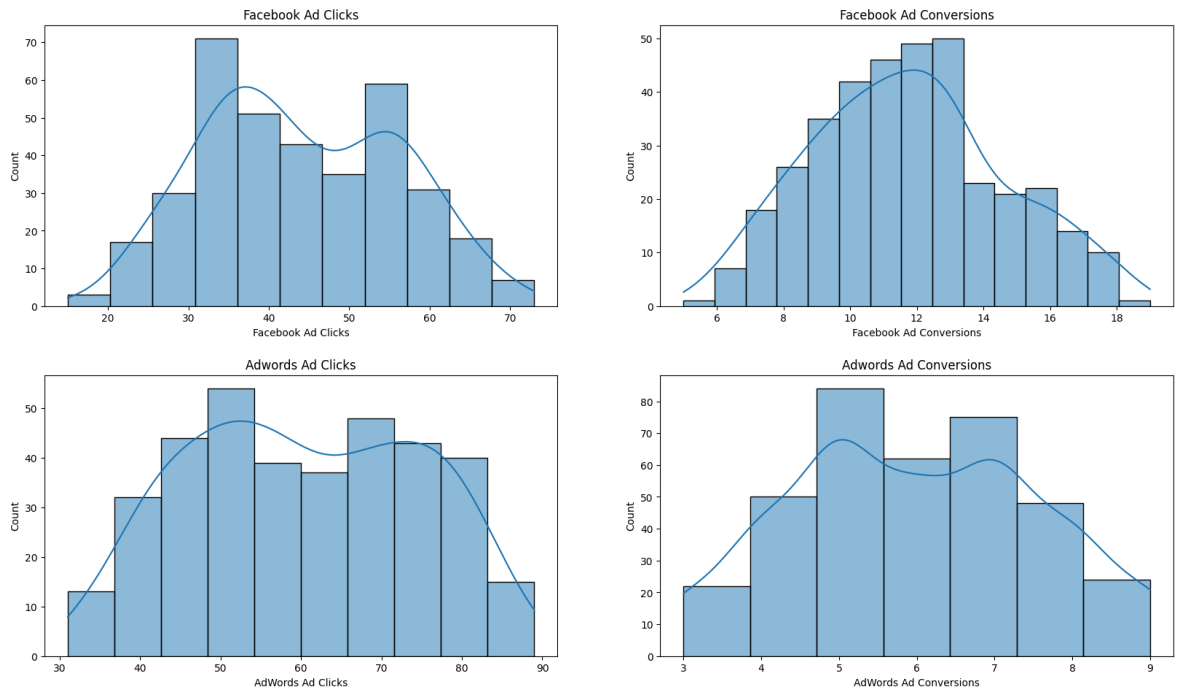
Comparing Campaigns Performance

```

In [9]: #distribution of clicks and conversions
plt.figure(figsize=(20,5))
plt.subplot(1,2,1)
plt.title("Facebook Ad Clicks")
sns.histplot(df["Facebook Ad Clicks"],kde = True)
plt.subplot(1,2,2)
plt.title("Facebook Ad Conversions")
sns.histplot(df["Facebook Ad Conversions"],bins = 15,kde = True)
plt.show()

plt.figure(figsize=(20,5))
plt.subplot(1,2,1)
plt.title("Adwords Ad Clicks")
sns.histplot(df["AdWords Ad Clicks"],kde = True)
plt.subplot(1,2,2)
plt.title("Adwords Ad Conversions")
sns.histplot(df["AdWords Ad Conversions"],bins= 7,kde = True)
plt.show()

```



We can see from the graph that the histogram plots are symmetrical and that means no outlier is present. Data points are almost evenly distributed.

how frequently do we observe days with high numbers of conversions compared to days with low number of conversions?

```
In [10]: # Creating function to calculate the category for the conversions
def create_conversion_category(conversion_col):
    category = []
    for conversion in df[conversion_col]:
        if conversion < 6:
            category.append('Less than 6')
        elif 6 <= conversion < 11:
            category.append('6 - 10')
        elif 11 <= conversion < 16:
            category.append('11 - 15')
        else:
            category.append('More than 15')
    return category

# applying function for facebook and adwords' conversions
df["Facebook Conversions Category"] = create_conversion_category("Facebook Ad Co
df["AdWords Conversions Category"] = create_conversion_category("AdWords Ad Conv
```

```
In [11]: df[["Facebook Ad Conversions", "Facebook Conversions Category", "AdWords Ad Conversions", "AdWords Conversions Category"]]
```

Out[11]:

	Facebook Ad Conversions	Facebook Conversions Category	AdWords Ad Conversions	AdWords Conversions Category
0	8	6 - 10	5	Less than 6
1	12	11 - 15	6	6 - 10
2	8	6 - 10	4	Less than 6
3	9	6 - 10	5	Less than 6
4	7	6 - 10	7	6 - 10

In [12]: `df['Facebook Conversions Category'].value_counts()`

Out[12]: Facebook Conversions Category
11 - 15 189
6 - 10 128
More than 15 47
Less than 6 1
Name: count, dtype: int64

In [13]: `df['AdWords Conversions Category'].value_counts()`

Out[13]: AdWords Conversions Category
6 - 10 209
Less than 6 156
Name: count, dtype: int64

In [14]: `facebook = pd.DataFrame(df['Facebook Conversions Category'].value_counts()).reset_index()`

Out[14]:

	Category	count
0	11 - 15	189
1	6 - 10	128
2	More than 15	47
3	Less than 6	1

In [15]: `adwords = pd.DataFrame(df['AdWords Conversions Category'].value_counts()).reset_index()`

Out[15]:

	Category	count
0	6 - 10	209
1	Less than 6	156

In [16]: `category_df = pd.merge(facebook, adwords, on = 'Category', how = 'outer').fillna(0)`

```
Out[16]:
```

	Category	count_x	count_y
0	11 - 15	189	0.0
1	6 - 10	128	209.0
2	Less than 6	1	156.0
3	More than 15	47	0.0

```
In [17]: category_df = category_df.iloc[[2,1,0,3]]
```

```
In [18]: category_df
```

```
Out[18]:
```

	Category	count_x	count_y
2	Less than 6	1	156.0
1	6 - 10	128	209.0
0	11 - 15	189	0.0
3	More than 15	47	0.0

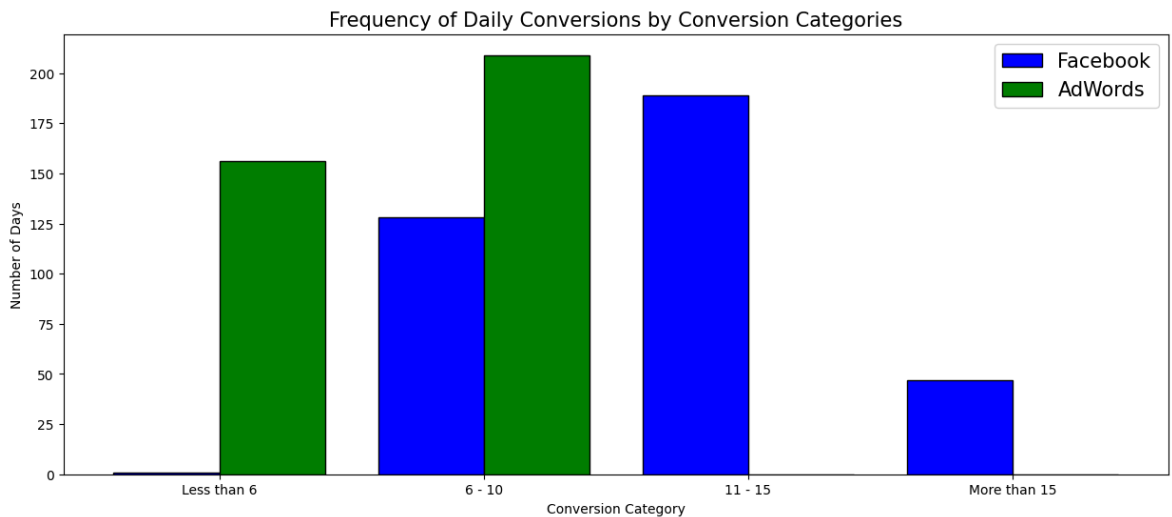
```
In [19]: category_df.rename(columns = {'count_x':'Facebook','count_y':'AdWords'},inplace=
category_df
```

```
Out[19]:
```

	Category	Facebook	AdWords
2	Less than 6	1	156.0
1	6 - 10	128	209.0
0	11 - 15	189	0.0
3	More than 15	47	0.0

```
In [20]: X_axis = np.arange(len(category_df))
plt.figure(figsize = (15,6))
plt.bar(X_axis - 0.2, category_df['Facebook'], 0.4, label = 'Facebook', color =
plt.bar(X_axis + 0.2, category_df['AdWords'], 0.4, label = 'AdWords', color = 'g

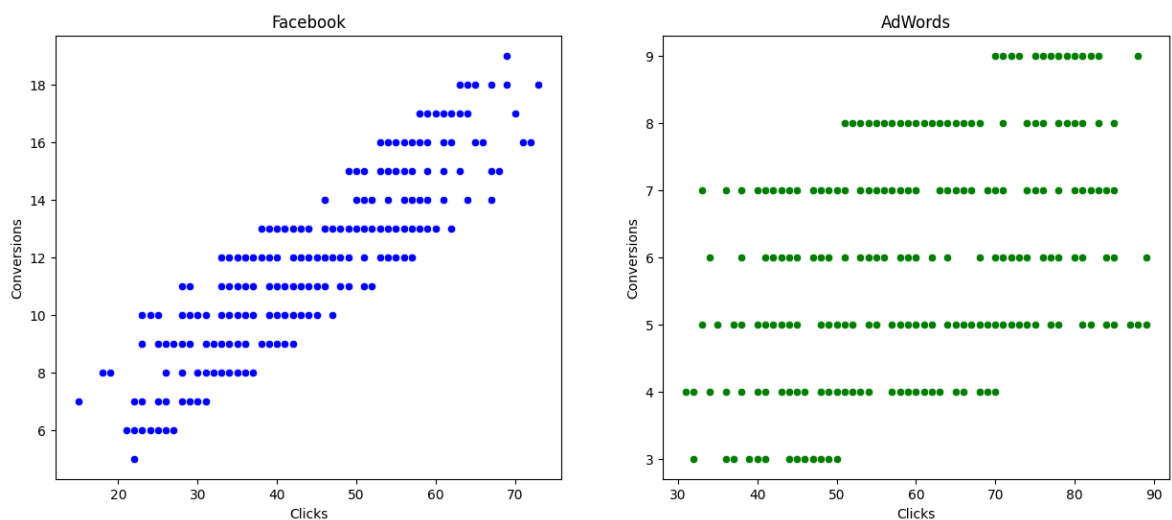
plt.xticks(X_axis, category_df['Category'])
plt.xlabel("Conversion Category")
plt.ylabel("Number of Days")
plt.title("Frequency of Daily Conversions by Conversion Categories", fontsize =
plt.legend(fontsize = 15)
plt.show()
```



- The data suggests Facebook had more frequent higher conversion days than AdWords, which either had very low conversion rates (less than 6) or moderate ones (6-10).
- There is a significant variance in the number of high-conversion days between two different campaigns.
- The absence of any days with conversions between 10-15 and more than 15 in AdWords indicates a need to review what strategies were changed or what external factors could have influenced these numbers.

Do more clicks on the ad really lead to conversions?

```
In [21]: plt.figure(figsize=(15,6))
plt.subplot(1,2,1)
plt.title('Facebook')
sns.scatterplot(x = df['Facebook Ad Clicks'], y = df['Facebook Ad Conversions'],
plt.xlabel('Clicks')
plt.ylabel('Conversions')
plt.subplot(1,2,2)
plt.title('AdWords')
sns.scatterplot(x = df['AdWords Ad Clicks'], y = df['AdWords Ad Conversions'], c
plt.xlabel('Clicks')
plt.ylabel('Conversions')
plt.show()
```




```
In [22]: facebook_corr = df[['Facebook Ad Conversions', 'Facebook Ad Clicks']].corr()  
facebook_corr
```

```
Out[22]:
```

	Facebook Ad Conversions	Facebook Ad Clicks
Facebook Ad Conversions	1.000000	0.873775
Facebook Ad Clicks	0.873775	1.000000

```
In [23]: adwords_corr = df[['AdWords Ad Conversions', 'AdWords Ad Clicks']].corr()  
adwords_corr
```

```
Out[23]:
```

	AdWords Ad Conversions	AdWords Ad Clicks
AdWords Ad Conversions	1.000000	0.447993
AdWords Ad Clicks	0.447993	1.000000

```
In [24]: print('Correlation Coefficient \n-----')  
print('Facebook :', round(facebook_corr.values[0,1],2))  
print('AdWords :', round(adwords_corr.values[0,1],2))
```

Correlation Coefficient

Facebook : 0.87

AdWords : 0.45

- A correlation coefficient of 0.87 indicates a strong positive relationship between clicks on Facebook ads and conversions. This suggests that as the number of clicks on Facebook ads increases, sales tend to increase as well.
- This strong correlation suggests that Facebook ads are highly effective in driving sales, as a large portion of the variation in sales can be explained by the variation in clicks on Facebook ads.
- This strong correlation between Facebook ads and conversions suggests that Facebook advertising is highly effective in driving sales for the business. Increasing investment in Facebook ads or optimizing their performance could potentially lead to even higher sales.
- A correlation coefficient of 0.45 indicates a moderate positive relation between clicks on AdWords ads and conversions. While there is still a positive relationship, it is not as strong as with Facebook ads. It does contribute to sales but its effectiveness may be influenced by other factors.

Regression Analysis -

What will happen when we go with Facebook Ad? How many Facebook Ad conversions can we expect given a certain number of ad clicks?

```
In [25]: import warnings  
warnings.filterwarnings('ignore')  
from sklearn.linear_model import LinearRegression
```

```
lr=LinearRegression()
from sklearn.metrics import r2_score, mean_squared_error
```

```
In [26]: # Independent Variable
X = df[['Facebook Ad Clicks']]

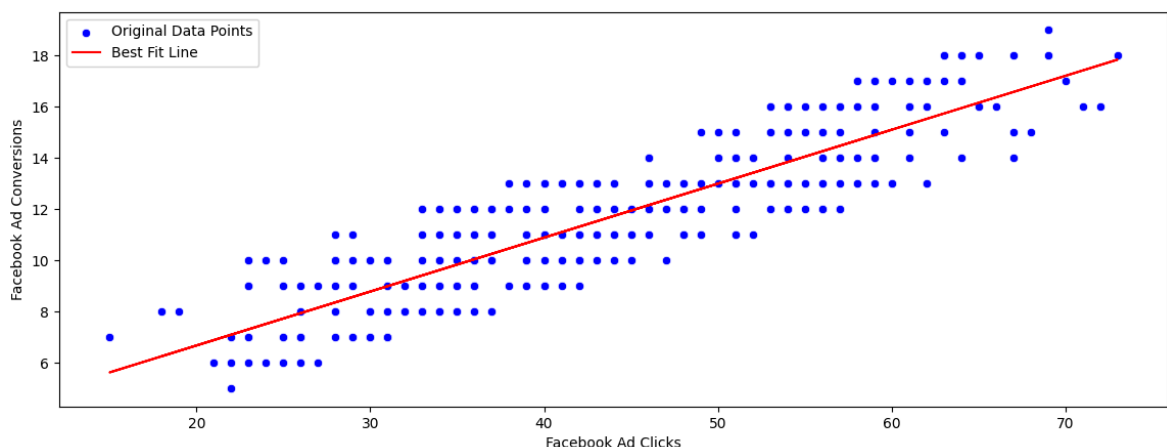
# Dependent Variable
y = df[['Facebook Ad Conversions']]

# fitting the model
lr.fit(X,y)
pred = lr.predict(X)

# evaluation of model
r2 = r2_score(y,pred)*100
mse = mean_squared_error(y,pred)
print("Accuracy(R2 Score) :",round(r2,2),'%')
print('Mean Squared Error :',round(mse,2))
```

Accuracy(R2 Score) : 76.35 %
Mean Squared Error : 2.02

```
In [27]: plt.figure(figsize = (14,5))
sns.scatterplot(x = df['Facebook Ad Clicks'], y = df['Facebook Ad Conversions'],
plt.plot(df['Facebook Ad Clicks'], pred, color = 'red', label = 'Best Fit Line')
plt.legend()
plt.show()
```



```
In [28]: print(f"For {50} Clicks, Expected Conversion : {round(lr.predict([[50]])[0][0],0)}")
For 50 Clicks, Expected Conversion : 13.0
```

Predict your conversion

```
In [29]: a = int(input("Write the clicks number for getting predicted"))
print(f"For {a} Clicks, Expected Conversion : {round(lr.predict([[a]])[0][0],0)}")
For 200 Clicks, Expected Conversion : 45.0
```

- The model has a reasonably good predictive power, with an R2 score of 76.35%. This suggests that it can predict Facebook ad conversions almost 76% accurate based on the number of Facebook ad clicks.

- With the insights provided by the Linear Regression model, business can make informed decisions about resource allocation, budget planning, and campaign optimization.
- Knowing the expected number of Facebook ad conversions based on a certain number of ad clicks can help in setting realistic campaign goals, optimizing ad spend, and assessing the ROI of Facebook Advertising effort.