Ola_Churn_Analysis

Python Internship Project-

Define Problem Statement and Perform Exploratory Data Analysis

Question 1-Definition of Problem:

Understand the challenge of driver attrition and its impact on Ola.

Answer-Many drivers leave Ola frequently or switch to Uber for better pay. This makes it hard for Ola to maintain a stable workforce. Finding and training new drivers costs a lot of money. It is cheaper to retain existing drivers than to keep hiring new ones. When too many drivers leave, it affects customer service, increases ride cancellations, and leads to longer wait times for passengers.

Impact on Ola: 1. Higher costs for hiring and training new drivers

2. Lower service quality due to driver shortages
3. Loss of experienced drivers, affecting customer satisfaction
4. Reduced profits because frequent hiring is expensive

[35]: Loading the data

```
import pandas as pd
df = pd.read_csv("ola_driver - ola_driver.csv")
```

[36]:

```
# Checking the data shape
df.shape
```

[36]:

```
(19104, 14)
```

Checking the data type of each column

[37]:

```
#checking the data type of each column
df.dtypes
```

[37] :

```
Unnamed: 0                    int64
MMM-YY                       object
Driver_ID                     int64
Age                         float64
```

```
Gender                  float64
City                     object
Education_Level           int64
Income                    int64
Dateofjoining            object
LastWorkingDate          object
Joining Designation       int64
Grade                     int64
Total Business Value      int64
Quarterly Rating          int64
dtype: object
```

Conversion to text data types

```
[38]: # conversion to text data types
column_data_type_conversion = ["Driver_ID", "Gender", "Education_Level",␣
  ↪"Joining Designation", "Grade"]

df[column_data_type_conversion] = df[column_data_type_conversion].astype(str)
```

Detect missing values

```
[39]: #Detect missing values
df.isnull().sum()
```

```
[39]: Unnamed: 0                  0
      MMM-YY                      0
      Driver_ID                   0
      Age                        61
      Gender                      0
      City                        0
      Education_Level             0
      Income                      0
      Dateofjoining               0
      LastWorkingDate         17488
      Joining Designation         0
      Grade                       0
      Total Business Value        0
      Quarterly Rating            0
      dtype: int64
```

Perform statistical summary to understand data distribution.

```
[40]: #Perform statistical summary to understand data distribution.
df.describe()
```

```
[40]:         Unnamed: 0           Age        Income  Total Business Value  \
      count  19104.000000  19043.000000  19104.000000          1.910400e+04
      mean    9551.500000     34.668435  65652.025126          5.716621e+05
```

```
std     5514.994107     6.257912   30914.515344           1.128312e+06
min        0.000000    21.000000   10747.000000          -6.000000e+06
25%     4775.750000    30.000000   42383.000000           0.000000e+00
50%     9551.500000    34.000000   60087.000000           2.500000e+05
75%    14327.250000    39.000000   83969.000000           6.997000e+05
max    19103.000000    58.000000  188418.000000           3.374772e+07

       Quarterly Rating
count      19104.000000
mean           2.008899
std            1.009832
min            1.000000
25%            1.000000
50%            2.000000
75%            3.000000
max            4.000000
```

Handle missing values using mean, median, or mode for numerical features.

[41] :

```python
#Handle missing values using mean, median, or mode for numerical features.
# filling null values of age column
df["Age"].fillna(df["Age"].mean(), inplace=True)
```

```
<ipython-input-41-a227f19ce7bc>:3: FutureWarning: A value is trying to be set on
a copy of a DataFrame or Series through chained assignment using an inplace
method.
The behavior will change in pandas 3.0. This inplace method will never work
because the intermediate object on which we are setting values always behaves as
a copy.

For example, when doing 'df[col].method(value, inplace=True)', try using
'df.method({col: value}, inplace=True)' or df[col] = df[col].method(value)
instead, to perform the operation inplace on the original object.


  df["Age"].fillna(df["Age"].mean(), inplace=True)
```

Feature Engineering: Create a target variable indicating whether a driver has left the company based on LastWorkingDate.

[42] :

```python
#Feature Engineering: Create a target variable indicating whether a driver has left the company based on LastWorkingDate.
df["Is_Driver_available"]=df["LastWorkingDate"].isnull().astype("int")
df.head()
```

```
/usr/local/lib/python3.11/dist-
packages/google/colab/_dataframe_summarizer.py:88: UserWarning: Could not infer
format, so each element will be parsed individually, falling back to `dateutil`.
To ensure parsing is consistent and as-expected, please specify a format.
```

```
  cast_date_col = pd.to_datetime(column, errors="coerce")
```

[42]:
```
   Unnamed: 0   MMM-YY  Driver_ID   Age  Gender City  Education_Level  Income  \
0           0  01/01/19          1  28.0     0.0  C23                2   57387
1           1  02/01/19          1  28.0     0.0  C23                2   57387
2           2  03/01/19          1  28.0     0.0  C23                2   57387
3           3  11/01/20          2  31.0     0.0   C7                2   67016
4           4  12/01/20          2  31.0     0.0   C7                2   67016

  Dateofjoining LastWorkingDate  Joining Designation  Grade  \
0      24/12/18             NaN                    1      1
1      24/12/18             NaN                    1      1
2      24/12/18        03/11/19                    1      1
3      11/06/20             NaN                    2      2
4      11/06/20             NaN                    2      2

   Total Business Value  Quarterly Rating  Is_Driver_available
0               2381060                 2                    1
1               -665480                 2                    1
2                     0                 2                    0
3                     0                 1                    1
4                     0                 1                    1
```

Calculate age of each driver based on Date Of Joining

[43] :
```
#Calculate age of each driver based on Date Of Joining

df["Dateofjoining"] = pd.to_datetime(df["Dateofjoining"])

df["Years_after_joining"] = pd.Timestamp.today().year - df["Dateofjoining"].dt.
  year


df["Current Age"] = df["Age"] + df["Years_after_joining"]


df[["Driver_ID", "Age", "Dateofjoining", "Current Age"]].head()
```

```
<ipython-input-43-7b30dd0180f2>:3: UserWarning: Could not infer format, so each
element will be parsed individually, falling back to `dateutil`. To ensure
parsing is consistent and as-expected, please specify a format.
  df["Dateofjoining"] = pd.to_datetime(df["Dateofjoining"])
```

[43] :
```
   Driver_ID   Age Dateofjoining  Current Age
0          1  28.0    2018-12-24         35.0
1          1  28.0    2018-12-24         35.0
2          1  28.0    2018-12-24         35.0
3          2  31.0    2020-11-06         36.0
```

```
4               2   31.0       2020-11-06              36.0
```

Determine if quarterly rating has increased (1 if yes, 0 if no).

[44] :

```python
#Determine if quarterly rating has increased (1 if yes, 0 if no).

df = df.sort_values(by=["Driver_ID", "MMM-YY"]) # firstly sorted the values in ascending order.
df["Rating_Increased"] = df.groupby("Driver_ID")["Quarterly Rating"].diff().gt(0).astype(int)
df
```

```
/usr/local/lib/python3.11/dist-
packages/google/colab/_dataframe_summarizer.py:88: UserWarning: Could not infer
format, so each element will be parsed individually, falling back to `dateutil`.
To ensure parsing is consistent and as-expected, please specify a format.
  cast_date_col = pd.to_datetime(column, errors="coerce")
```

[44]:

```
      Unnamed: 0    MMM-YY  Driver_ID   Age  Gender City  Education_Level  \
0              0  01/01/19          1  28.0     0.0  C23                2
1              1  02/01/19          1  28.0     0.0  C23                2
2              2  03/01/19          1  28.0     0.0  C23                2
6674        6674  01/01/20       1000  27.0     1.0   C3                2
6675        6675  02/01/20       1000  28.0     1.0   C3                2
...          ...       ...        ...   ...     ...  ...              ...
6668        6668  08/01/20        999  23.0     1.0  C20                1
6669        6669  09/01/20        999  23.0     1.0  C20                1
6670        6670  10/01/20        999  23.0     1.0  C20                1
6671        6671  11/01/20        999  23.0     1.0  C20                1
6672        6672  12/01/20        999  23.0     1.0  C20                1

      Income Dateofjoining  LastWorkingDate Joining  Designation  Grade  \
0      57387    2018-12-24              NaN                    1      1
1      57387    2018-12-24              NaN                    1      1
2      57387    2018-12-24         03/11/19                    1      1
6674   56016    2019-11-28              NaN                    1      1
6675   56016    2019-11-28              NaN                    1      1
...      ...           ...              ...                  ...    ...
6668   36811    2020-05-05              NaN                    2      2
6669   36811    2020-05-05              NaN                    2      2
6670   36811    2020-05-05              NaN                    2      2
6671   36811    2020-05-05              NaN                    2      2
6672   36811    2020-05-05              NaN                    2      2

      Total Business Value  Quarterly Rating  Is_Driver_available    \
0                  2381060                 2                    1
1                  -665480                 2                    1
2                        0                 2                    0
```

```
6674                     0                    1                     1
6675                     0                    1                     1
...                    ...                  ...                   ...
6668                180170                    2                     1
6669                274440                    2                     1
6670                845830                    2                     1
6671                     0                    2                     1
6672                247400                    2                     1

      Years_after_joining  Current Age  Rating_Increased
0                       7         35.0                 0
1                       7         35.0                 0
2                       7         35.0                 0
6674                    6         33.0                 0
6675                    6         34.0                 0
...                   ...          ...               ...
6668                    5         28.0                 0
6669                    5         28.0                 0
6670                    5         28.0                 0
6671                    5         28.0                 0
6672                    5         28.0                 0

[19104 rows x 18 columns]
```

Identify if monthly income has increased (1 if yes, 0 if no).

[45]:

```
#Identify if monthly income has increased (1 if yes, 0 if no).
df["Month"] = pd.to_datetime(df["MMM-YY"]).dt.to_period("M")     # Converting to␣
↪month format
df["Is_Income_Increased"] = df.groupby(["Driver_ID", "Month"])["Income"].diff().
↪gt(0).astype(int)
df
```

```
<ipython-input-45-c2c982de9ffa>:2: UserWarning: Could not infer format, so each
element will be parsed individually, falling back to `dateutil`. To ensure
parsing is consistent and as-expected, please specify a format.
  df["Month"] = pd.to_datetime(df["MMM-YY"]).dt.to_period("M")     # Converting to
month format
/usr/local/lib/python3.11/dist-
packages/google/colab/_dataframe_summarizer.py:88: UserWarning: Could not infer
format, so each element will be parsed individually, falling back to `dateutil`.
To ensure parsing is consistent and as-expected, please specify a format.
  cast_date_col = pd.to_datetime(column, errors="coerce")
```

[45]:

```
      Unnamed: 0    MMM-YY  Driver_ID   Age Gender City  Education_Level  \
0              0  01/01/19          1  28.0    0.0  C23                2
1              1  02/01/19          1  28.0    0.0  C23                2
2              2  03/01/19          1  28.0    0.0  C23                2
```

```
6674          6674  01/01/20       1000  27.0     1.0    C3              2
6675          6675  02/01/20       1000  28.0     1.0    C3              2
...           ...     ...        ...   ...    ...  ...           ...
6668          6668  08/01/20        999  23.0     1.0   C20              1
6669          6669  09/01/20        999  23.0     1.0   C20              1
6670          6670  10/01/20        999  23.0     1.0   C20              1
6671          6671  11/01/20        999  23.0     1.0   C20              1
6672          6672  12/01/20        999  23.0     1.0   C20              1

      Income  Dateofjoining  LastWorkingDate Joining  Designation  Grade  \
0      57387     2018-12-24              NaN                    1      1
1      57387     2018-12-24              NaN                    1      1
2      57387     2018-12-24         03/11/19                    1      1
6674   56016     2019-11-28              NaN                    1      1
6675   56016     2019-11-28              NaN                    1      1
...      ...            ...          ...                  ...    ...
6668   36811     2020-05-05              NaN                    2      2
6669   36811     2020-05-05              NaN                    2      2
6670   36811     2020-05-05              NaN                    2      2
6671   36811     2020-05-05              NaN                    2      2
6672   36811     2020-05-05              NaN                    2      2

      Total  Business  Value   Quarterly  Rating  Is_Driver_available   \
0                    2381060                  2                     1
1                    -665480                  2                     1
2                          0                  2                     0
6674                       0                  1                     1
6675                       0                  1                     1
...                      ...            ...                   ...
6668                  180170                  2                     1
6669                  274440                  2                     1
6670                  845830                  2                     1
6671                       0                  2                     1
6672                  247400                  2                     1

      Years_after_joining   Current Age  Rating_Increased     Month   \
0                       7          35.0                 0   2019-01
1                       7          35.0                 0   2019-02
2                       7          35.0                 0   2019-03
6674                    6          33.0                 0   2020-01
6675                    6          34.0                 0   2020-02
...                   ...          ...            ...       ...
6668                    5          28.0                 0   2020-08
6669                    5          28.0                 0   2020-09
6670                    5          28.0                 0   2020-10
6671                    5          28.0                 0   2020-11
6672                    5          28.0                 0   2020-12
```

```
         Is_Income_Increased
0                          0
1                          0
2                          0
6674                       0
6675                       0
...                      ...
6668                       0
6669                       0
6670                       0
6671                       0
6672                       0

[19104 rows x 20 columns]
```

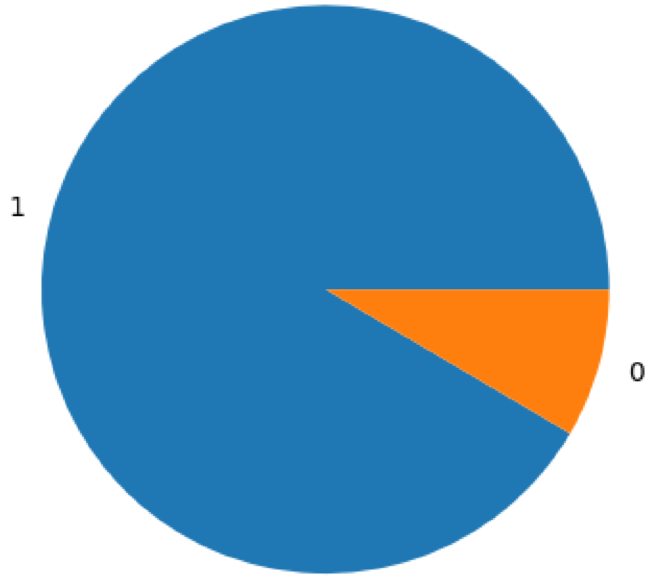
Check for class imbalance in the target variable.

```
[46]: #Check for class imbalance in the target variable.
      Driver_available_vs_not_available=df["Is_Driver_available"].value_counts()
      Driver_available_vs_not_available
```

```
[46]: Is_Driver_available
      1    17488
      0     1616
      Name: count, dtype: int64
```

```
[47]: #Check for class imbalance in the target variable.
      import matplotlib.pyplot as plt
      plt.
        pie(Driver_available_vs_not_available,labels=Driver_available_vs_not_available.
        index)
```

```
[47]: ([<matplotlib.patches.Wedge at 0x7bac56045b50>,
        <matplotlib.patches.Wedge at 0x7bac53f42690>],
       [Text(-1.0613865244046894, 0.2888921006398996, '1'),
        Text(1.0613865496604358, -0.2888920078505379, '0')])
```



Insights from above graph-

Class Imbalance Observed-

1. There is a significant class imbalance in the Is_Driver_available variable.
2. 17,488 drivers (91.55%) are available, while 1,616 drivers (8.45%) are not available.

Potential Issues Due to Imbalance-

1. If used for a predictive model, the imbalance might cause biased results.
2. The model may favor the majority class (drivers available) and underperform in predicting driver churn.

What is the structure of the dataset (number of rows and columns)

[48] :

```
#What is the structure of the dataset (number of rows and columns)
df.shape
```

[48]:

```
(19104, 20)
```

What are the data types of each column?

[49] :

```
#What are the data types of each column?
df.dtypes
```

```
[49]: Unnamed: 0                        int64
      MMM-YY                          object
      Driver_ID                       object
      Age                            float64
      Gender                          object
      City                            object
      Education_Level                 object
      Income                           int64
      Dateofjoining           datetime64[ns]
      LastWorkingDate                 object
      Joining Designation             object
      Grade                           object
      Total Business Value             int64
      Quarterly Rating                 int64
      Is_Driver_available              int64
      Years_after_joining              int32
      Current Age                    float64
      Rating_Increased                 int64
      Month                        period[M]
      Is_Income_Increased              int64
      dtype: object
```

Are there any missing values in the dataset? If so, which columns are affected?

```
[50]: #Are there any missing values in the dataset? If so, which columns are affected?
      df.isnull().sum()
```

```
[50]: Unnamed: 0                  0
      MMM-YY                      0
      Driver_ID                   0
      Age                         0
      Gender                      0
      City                        0
      Education_Level             0
      Income                      0
      Dateofjoining               0
      LastWorkingDate         17488
      Joining Designation         0
      Grade                       0
      Total Business Value        0
      Quarterly Rating            0
      Is_Driver_available         0
      Years_after_joining         0
      Current Age                 0
      Rating_Increased            0
      Month                       0
      Is_Income_Increased         0
      dtype: int64
```

What are the basic statistics (mean, median, standard deviation) for numerical features like Age, Income, Total Business Value, and Quarterly Rating?

[51]:
```python
#What are the basic statistics (mean, median, standard deviation) for numerical features like Age, Income, Total Business Value, and Quarterly Rating?
column_data_type_conversion = ["Driver_ID", "Gender", "Education_Level", "Joining Designation", "Grade"]

df[column_data_type_conversion] = df[column_data_type_conversion].astype(str)

df.describe()
```

[51]:
```
        Unnamed: 0           Age         Income  \
count  19104.000000  19104.000000   19104.000000
mean    9551.500000     34.668435   65652.025126
min        0.000000     21.000000   10747.000000
25%     4775.750000     30.000000   42383.000000
50%     9551.500000     34.000000   60087.000000
75%    14327.250000     39.000000   83969.000000
max    19103.000000     58.000000  188418.000000
std     5514.994107      6.247912   30914.515344

                       Dateofjoining  Total Business Value  Quarterly Rating  \
count                          19104          1.910400e+04      19104.000000
mean   2018-04-28 20:52:54.874372096          5.716621e+05          2.008899
min              2013-04-01 00:00:00         -6.000000e+06          1.000000
25%              2016-11-29 12:00:00          0.000000e+00          1.000000
50%              2018-09-12 00:00:00          2.500000e+05          2.000000
75%              2019-11-05 00:00:00          6.997000e+05          3.000000
max              2020-12-28 00:00:00          3.374772e+07          4.000000
std                              NaN          1.128312e+06          1.009832

       Is_Driver_available  Years_after_joining   Current Age  \
count         19104.000000         19104.000000  19104.000000
mean              0.915410             7.223670     41.892105
min               0.000000             5.000000     26.000000
25%               1.000000             6.000000     37.000000
50%               1.000000             7.000000     41.000000
75%               1.000000             9.000000     47.000000
max               1.000000            12.000000     65.000000
std               0.278277             1.920872      7.038238

       Rating_Increased  Is_Income_Increased
count      19104.000000              19104.0
mean           0.146200                  0.0
min            0.000000                  0.0
25%            0.000000                  0.0
```

```
50%         0.000000            0.0
75%         0.000000            0.0
max         1.000000            0.0
std         0.353316            0.0
```

How many unique drivers are there in the dataset?

[52] :
```
#How many unique drivers are there in the dataset?
df["Driver_ID"].nunique()
```

[52]:
```
2381
```

How many drivers joined each month?

[53] :
```
#How many drivers joined each month?
df["Dateofjoining"] = pd.to_datetime(df["Dateofjoining"]) # conversion of column to date format
df["LastWorkingDate"]  =  pd.to_datetime(df["LastWorkingDate"],errors="coerce")

df["Joining_Month"] = df["Dateofjoining"].dt.month # extraction of month from date
df["Leaving_month"] = df["LastWorkingDate"].dt.month

joins_per_month  =  df["Joining_Month"].value_counts().sort_index()  #  counting how many driver joined each month
exits_per_month  =  df["Leaving_month"].value_counts().sort_index()

joins_per_month
```

```
<ipython-input-53-04a2a9c86f3a>:3: UserWarning: Could not infer format, so each
element will be parsed individually, falling back to `dateutil`. To ensure
parsing is consistent and as-expected, please specify a format.
  df["LastWorkingDate"]  =  pd.to_datetime(df["LastWorkingDate"],errors="coerce")
```

[53] :
```
Joining_Month
1      1381
2       684
3       402
4      1014
5      2362
6      1973
7      2730
8      1886
9      1449
10     2095
11     1867
12     1261
Name: count, dtype: int64
```

How many drivers left each month?

[54]:

```
df["Dateofjoining"] = pd.to_datetime(df["Dateofjoining"]) # conversion of column to date format
df["LastWorkingDate"]  =  pd.to_datetime(df["LastWorkingDate"],errors="coerce")

df["Joining_Month"] = df["Dateofjoining"].dt.month # extraction of month from date
df["Leaving_month"] = df["LastWorkingDate"].dt.month

joins_per_month  =  df["Joining_Month"].value_counts().sort_index()  #  counting how many driver left each month
left_per_month  =  df["Leaving_month"].value_counts().sort_index()

left_per_month
```

[54]:

```
Leaving_month
1.0     152
2.0     155
3.0     133
4.0      91
5.0     161
6.0     138
7.0     189
8.0      57
9.0     145
10.0    132
11.0    142
12.0    121
Name: count, dtype: int64
```

Can we determine the average tenure of drivers in the dataset?

[55]:

```
#Can we determine the average tenure of drivers in the dataset?

# Converting columns to datetime format
df["Dateofjoining"]  =  pd.to_datetime(df["Dateofjoining"],  errors="coerce")
df["LastWorkingDate"]  =  pd.to_datetime(df["LastWorkingDate"],  errors="coerce")

# Replacing missing values in LastWorkingDate with today's date.
df["LastWorkingDate"].fillna(pd.to_datetime("today"),  inplace=True)

# Calculating total number of days drivers worked
df["Total_no_of_days"]  =  (df["LastWorkingDate"]  -  df["Dateofjoining"]).dt.days

# Calculating average days
average_tenure = df["Total_no_of_days"].mean()
```

```
average_tenure
```

```
<ipython-input-55-9d2bc88ea722>:8: FutureWarning: A value is trying to be set on
a copy of a DataFrame or Series through chained assignment using an inplace
method.
The behavior will change in pandas 3.0. This inplace method will never work
because the intermediate object on which we are setting values always behaves as
a copy.

For example, when doing 'df[col].method(value, inplace=True)', try using
'df.method({col: value}, inplace=True)' or df[col] = df[col].method(value)
instead, to perform the operation inplace on the original object.


  df["LastWorkingDate"].fillna(pd.to_datetime("today"), inplace=True)
```

[55]:

```
np.float64(2362.453465242881)
```

Average tenure of drivers is 2361 days

How can we create a target variable to indicate whether a driver has left the company based on LastWorkingDate?

[56]:

```
#How can we create a target variable to indicate whether a driver has left the company based on LastWorkingDate?
df["Is_Driver_available"]=df["LastWorkingDate"].isnull().astype("int")
df
```

[56]:

```
      Unnamed: 0    MMM-YY  Driver_ID   Age  Gender City  Education_Level  \
0              0  01/01/19          1  28.0     0.0  C23                2
1              1  02/01/19          1  28.0     0.0  C23                2
2              2  03/01/19          1  28.0     0.0  C23                2
6674        6674  01/01/20       1000  27.0     1.0   C3                2
6675        6675  02/01/20       1000  28.0     1.0   C3                2
...          ...       ...        ...   ...     ...  ...              ...
6668        6668  08/01/20        999  23.0     1.0  C20                1
6669        6669  09/01/20        999  23.0     1.0  C20                1
6670        6670  10/01/20        999  23.0     1.0  C20                1
6671        6671  11/01/20        999  23.0     1.0  C20                1
6672        6672  12/01/20        999  23.0     1.0  C20                1

      Income Dateofjoining            LastWorkingDate  ... Quarterly Rating  \
0      57387    2018-12-24 2025-03-28 06:50:44.051884  ...                2
1      57387    2018-12-24 2025-03-28 06:50:44.051884  ...                2
2      57387    2018-12-24 2019-03-11 00:00:00.000000  ...                2
6674   56016    2019-11-28 2025-03-28 06:50:44.051884  ...                1
6675   56016    2019-11-28 2025-03-28 06:50:44.051884  ...                1
...      ...           ...                        ...  ...              ...
6668   36811    2020-05-05 2025-03-28 06:50:44.051884  ...                2
```

```
6669    36811     2020-05-05 2025-03-28 06:50:44.051884     ...              2
6670    36811     2020-05-05 2025-03-28 06:50:44.051884     ...              2
6671    36811     2020-05-05 2025-03-28 06:50:44.051884     ...              2
6672    36811     2020-05-05 2025-03-28 06:50:44.051884     ...              2

      Is_Driver_available   Years_after_joining   Current Age  Rating_Increased   \
0                       0                     7          35.0                 0
1                       0                     7          35.0                 0
2                       0                     7          35.0                 0
6674                    0                     6          33.0                 0
6675                    0                     6          34.0                 0
...                   ...                   ...           ...               ...
6668                    0                     5          28.0                 0
6669                    0                     5          28.0                 0
6670                    0                     5          28.0                 0
6671                    0                     5          28.0                 0
6672                    0                     5          28.0                 0

         Month   Is_Income_Increased   Joining_Month  Leaving_month  \
0      2019-01                     0              12            NaN
1      2019-02                     0              12            NaN
2      2019-03                     0              12            3.0
6674   2020-01                     0              11            NaN
6675   2020-02                     0              11            NaN
...        ...                   ...             ...            ...
6668   2020-08                     0               5            NaN
6669   2020-09                     0               5            NaN
6670   2020-10                     0               5            NaN
6671   2020-11                     0               5            NaN
6672   2020-12                     0               5            NaN

       Total_no_of_days
0                  2286
1                  2286
2                    77
6674               1947
6675               1947
...                 ...
6668               1788
6669               1788
6670               1788
6671               1788
6672               1788

[19104 rows x 23 columns]
```

What additional features can we extract from Dateofjoining, such as tenure or duration of employment?

[57] :
```python
#What additional features can we extract from Dateofjoining, such as tenure or duration of employment?
# Converting  Date of Joining column to datetime format
df["Dateofjoining"] = pd.to_datetime(df["Dateofjoining"], errors="coerce")
df["LastWorkingDate"] = pd.to_datetime(df["LastWorkingDate"], errors="coerce")

# Fill missing LastWorkingDate with today's date for active drivers
df["LastWorkingDate"].fillna(pd.to_datetime("today"), inplace=True)

# Calculating "Total_no_of_days", "Total_no_of_months", "Total_no_of_years" drivers  worked
df["Total_no_of_days"] = (df["LastWorkingDate"] - df["Dateofjoining"]).dt.days
df["Total_no_of_months"] = df["Total_no_of_days"] // 30   # Approximate months
df["Total_no_of_years"] = df["Total_no_of_days"] // 365   # Corrected years calculation

df
```

```
<ipython-input-57-5c4d31a09ec6>:7: FutureWarning: A value is trying to be set on
a copy of a DataFrame or Series through chained assignment using an inplace
method.
The behavior will change in pandas 3.0. This inplace method will never work
because the intermediate object on which we are setting values always behaves as
a copy.

For example, when doing 'df[col].method(value, inplace=True)', try using
'df.method({col: value}, inplace=True)' or df[col] = df[col].method(value)
instead, to perform the operation inplace on the original object.


  df["LastWorkingDate"].fillna(pd.to_datetime("today"), inplace=True)
```

[57]:
```
      Unnamed: 0    MMM-YY  Driver_ID   Age  Gender  City  Education_Level  \
0              0  01/01/19          1  28.0     0.0   C23                2
1              1  02/01/19          1  28.0     0.0   C23                2
2              2  03/01/19          1  28.0     0.0   C23                2
6674        6674  01/01/20       1000  27.0     1.0    C3                2
6675        6675  02/01/20       1000  28.0     1.0    C3                2
...          ...       ...        ...   ...     ...   ...              ...
6668        6668  08/01/20        999  23.0     1.0   C20                1
6669        6669  09/01/20        999  23.0     1.0   C20                1
6670        6670  10/01/20        999  23.0     1.0   C20                1
6671        6671  11/01/20        999  23.0     1.0   C20                1
6672        6672  12/01/20        999  23.0     1.0   C20                1

      Income Dateofjoining            LastWorkingDate  ...  \
0      57387    2018-12-24 2025-03-28 06:50:44.051884  ...
```

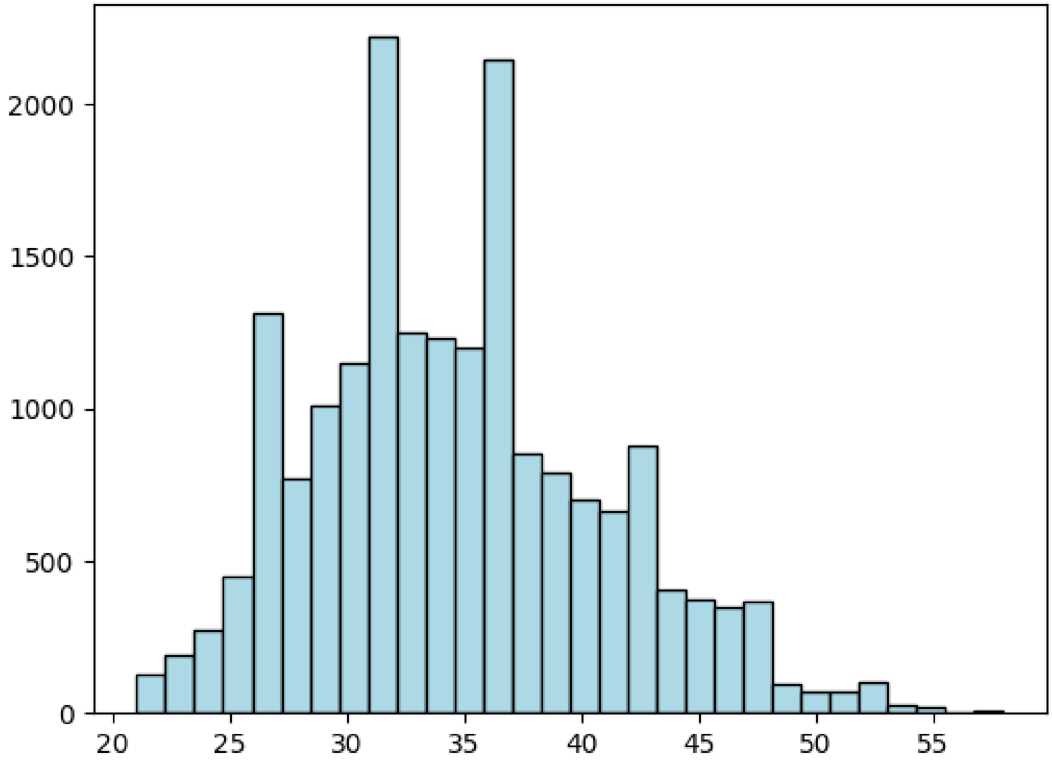
```
1      57387    2018-12-24  2025-03-28  06:50:44.051884 ...
2      57387    2018-12-24  2019-03-11  00:00:00.000000 ...
6674   56016    2019-11-28  2025-03-28  06:50:44.051884 ...
6675   56016    2019-11-28  2025-03-28  06:50:44.051884 ...
...    ...      ...                            ...   ...
6668   36811    2020-05-05  2025-03-28  06:50:44.051884 ...
6669   36811    2020-05-05  2025-03-28  06:50:44.051884 ...
6670   36811    2020-05-05  2025-03-28  06:50:44.051884 ...
6671   36811    2020-05-05  2025-03-28  06:50:44.051884 ...
6672   36811    2020-05-05  2025-03-28  06:50:44.051884 ...

      Years_after_joining  Current Age  Rating_Increased    Month  \
0                       7         35.0                 0  2019-01
1                       7         35.0                 0  2019-02
2                       7         35.0                 0  2019-03
6674                    6         33.0                 0  2020-01
6675                    6         34.0                 0  2020-02
...                   ...          ...               ...      ...
6668                    5         28.0                 0  2020-08
6669                    5         28.0                 0  2020-09
6670                    5         28.0                 0  2020-10
6671                    5         28.0                 0  2020-11
6672                    5         28.0                 0  2020-12

      Is_Income_Increased  Joining_Month  Leaving_month  Total_no_of_days  \
0                       0             12            NaN              2286
1                       0             12            NaN              2286
2                       0             12            3.0                77
6674                    0             11            NaN              1947
6675                    0             11            NaN              1947
...                   ...            ...            ...               ...
6668                    0              5            NaN              1788
6669                    0              5            NaN              1788
6670                    0              5            NaN              1788
6671                    0              5            NaN              1788
6672                    0              5            NaN              1788

      Total_no_of_months  Total_no_of_years
0                     76                  6
1                     76                  6
2                      2                  0
6674                  64                  5
6675                  64                  5
...                  ...                ...
6668                  59                  4
6669                  59                  4
6670                  59                  4
```

```
6671                        59                        4
6672                        59                        4

[19104 rows x 25 columns]
```

What are the distributions of Age, Income, and Total Business Value?

[58]:

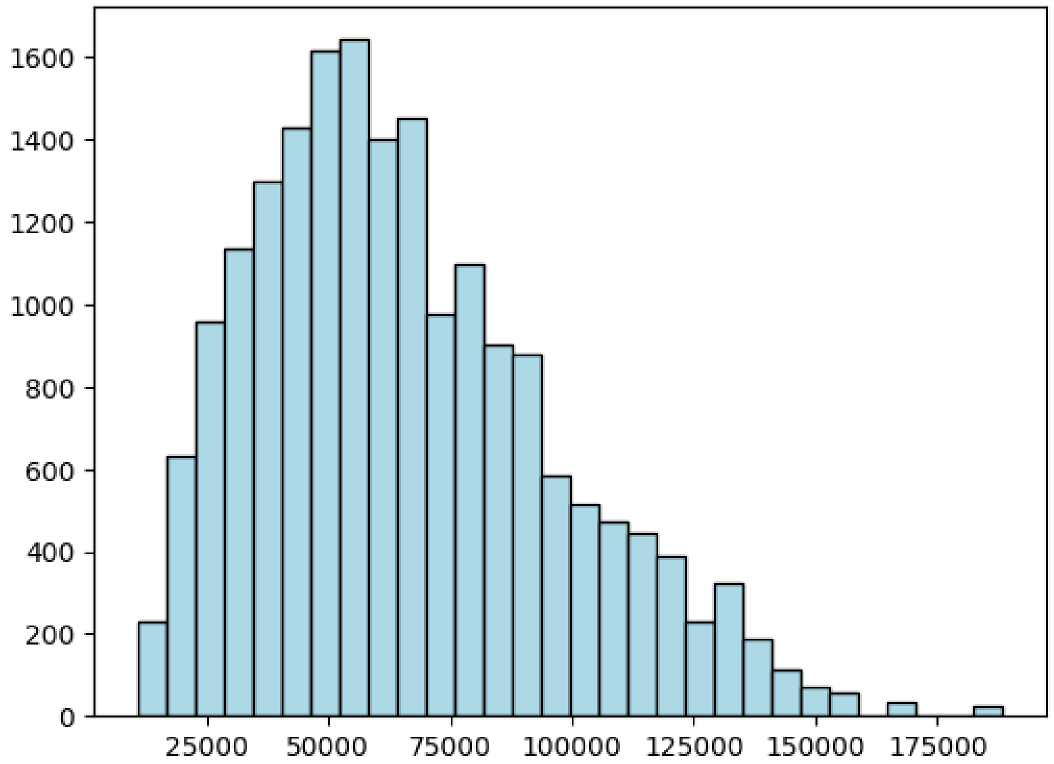
```python
#What are the distributions of Age, Income, and Total Business Value?
#What are the distributions of Age?
plt.hist(df["Age"],bins=30,color="lightblue",edgecolor="black")
plt.show()
```



Insights from above graph- 1. The histogram shows that the majority of drivers fall within the 30 to 40-year-old range. 2. There are fewer drivers below 25 and above 45, suggesting that younger individuals might not prefer this job or may lack the required driving experience. 3. Similarly, drivers above 50 years are very few, indicating that older individuals may leave the workforce earlier due to physical strain or other factors.

[59]:

```python
# distribution of income
plt.hist(df["Income"],bins=30,color="lightblue",edgecolor="black")
plt.show()
```

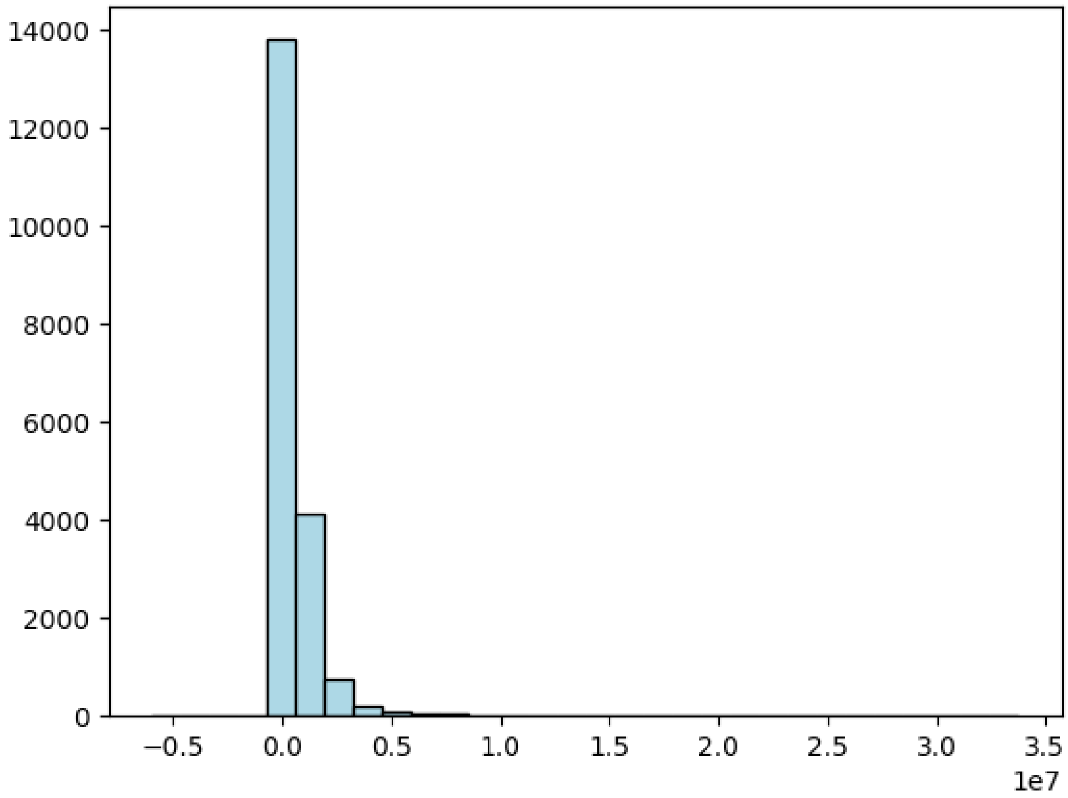


Insights from above graph-

1. Most drivers earn between 50,000 - 75,000.
2. Very few earn above 1,25,000, showing an income gap.
3. The income distribution is right-skewed, meaning fewer high earners.

[60] :

```
#What are the distributions of Total Business Value?
plt.hist(df["Total Business Value"],bins=30,color="lightblue",edgecolor="black")
plt.show()
```



Insights from above graph-

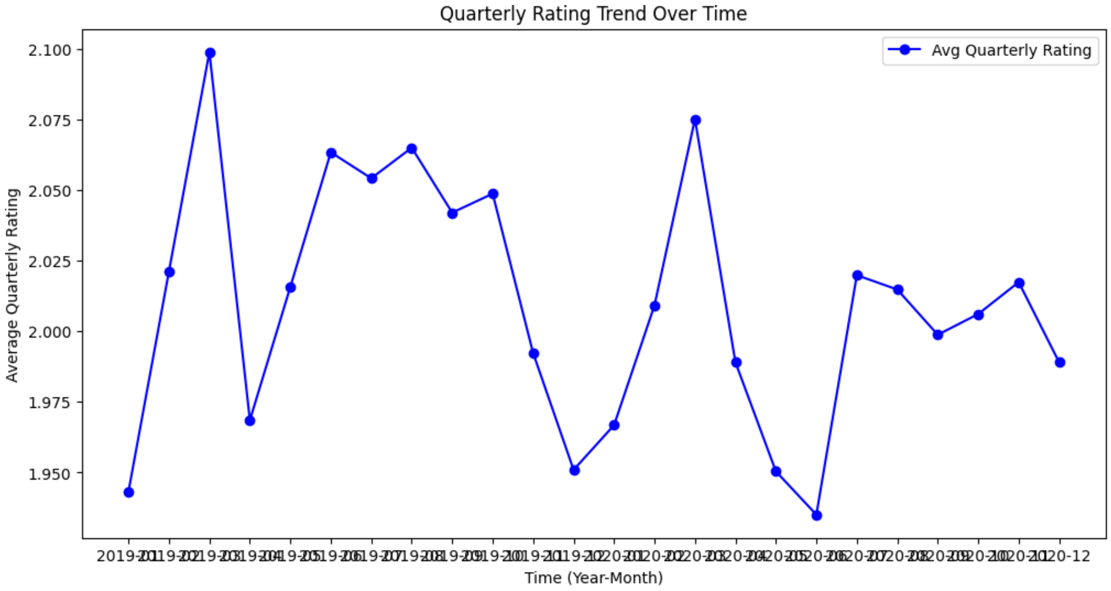
1. Most drivers have very low Total Business Value, clustered near zero.
2. A few drivers have very high values, creating a right-skewed distribution.
3. This suggests a few top performers contribute a significant share of the business.

How does Quarterly Rating vary across different drivers and time periods?

```
[61] : #How does Quarterly Rating vary across different drivers and time periods?
#conversion to datetime format
df["MMM-YY"] = pd.to_datetime(df["MMM-YY"])

#Extracting month from "MMM-YY" column
df["Month"]  =  df["MMM-YY"].dt.to_period("M")

# Calculating Average Quarter Rating for each month
rating_trend = df.groupby("Month")["Quarterly Rating"].mean()
# Line Graph
plt.figure(figsize=(12, 6))
plt.plot(rating_trend.index.astype(str), rating_trend.values, marker="o",
  linestyle="-", color="b", label="Avg Quarterly Rating")
```

```
plt.xlabel("Time (Year-Month)")
plt.ylabel("Average Quarterly Rating")
plt.title("Quarterly Rating Trend Over Time")
plt.legend()
plt.show()
```

```
<ipython-input-61-9df7aa66e31d>:3: UserWarning: Could not infer format, so each
element will be parsed individually, falling back to `dateutil`. To ensure
parsing is consistent and as-expected, please specify a format.
  df["MMM-YY"] = pd.to_datetime(df["MMM-YY"])
```



How should missing values in LastWorkingDate be treated, considering it indicates whether a driver has left?

[62]:

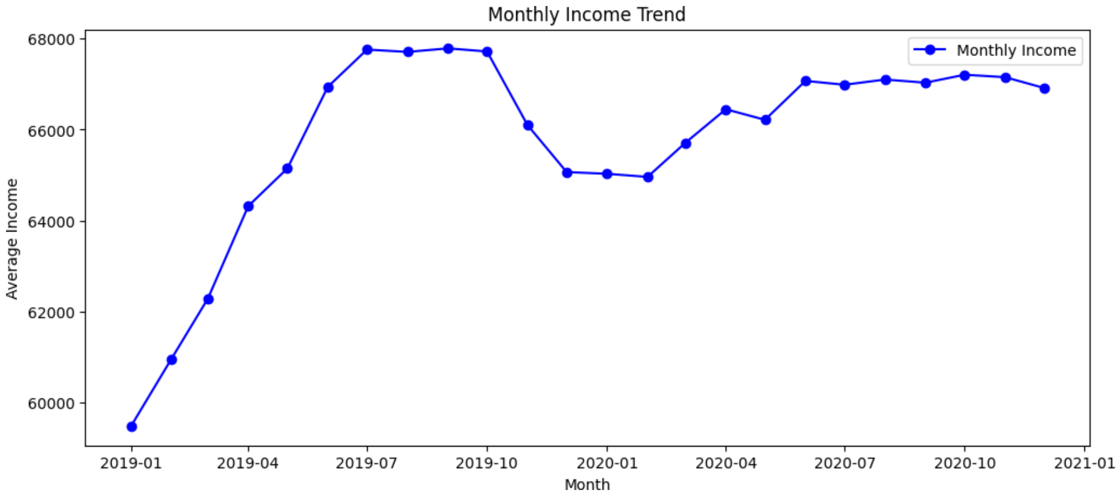
```
#How should missing values in LastWorkingDate be treated, considering it indicates whether a driver has left?
df["LastWorkingDate"].fillna("Present", inplace=True)
```

```
<ipython-input-62-3813c5cbbbdd>:2: FutureWarning: A value is trying to be set on
a copy of a DataFrame or Series through chained assignment using an inplace
method.
The behavior will change in pandas 3.0. This inplace method will never work
because the intermediate object on which we are setting values always behaves as
a copy.

For example, when doing 'df[col].method(value, inplace=True)', try using
'df.method({col: value}, inplace=True)' or df[col] = df[col].method(value)
instead, to perform the operation inplace on the original object.
```

```
df["LastWorkingDate"].fillna("Present", inplace=True)
```

Are there any trends or patterns in the monthly income or business value acquired?

[63] :
```
#Are there any trends or patterns in the monthly income or business value acquired?
#Converting "MMM-YY" column to datetime format
df["Month"] = pd.to_datetime(df["MMM-YY"])  # Auto-detects format

# Sort data in ascending order
df = df.sort_values(by="Month")

#calculating average income for each month
monthly_income_trend  =  df.groupby("Month")["Income"].mean()

# line chart
plt.figure(figsize=(12, 5))
plt.plot(monthly_income_trend, marker="o", linestyle="-", color="b", label="Monthly Income")
plt.xlabel("Month")
plt.ylabel("Average Income")
plt.title("Monthly Income Trend")
plt.legend()
plt.show()
```



Insights-

Strong Growth Phase (Early 2019 - Mid 2019): The monthly income showed a steady upward trend, indicating increasing demand and business expansion.

Decline & Fluctuations (Late 2019 - Early 2020): A noticeable dip in income occurred, possibly due to seasonality, market shifts, or external factors like competition or economic slowdowns.

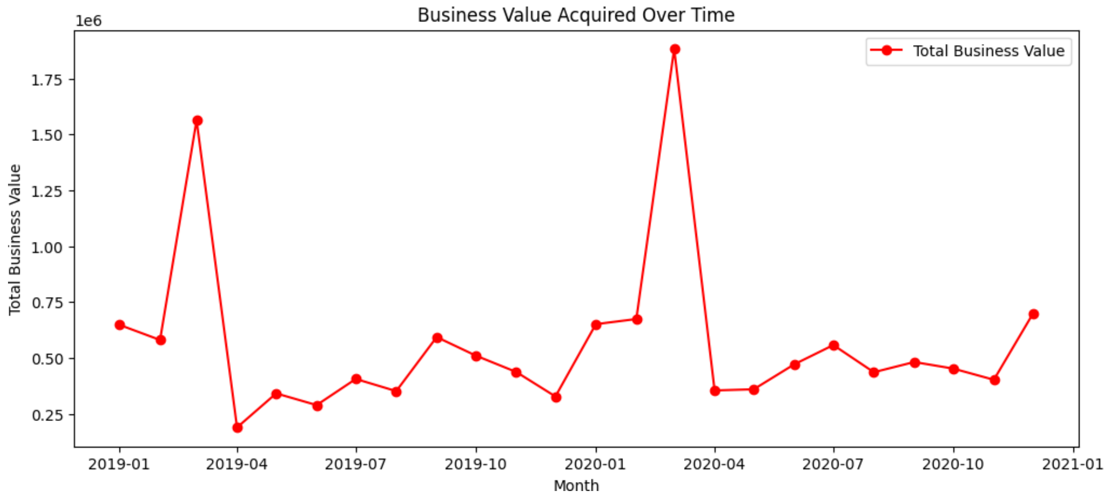
Recovery & Stability (Mid 2020 - 2021): The business recovered from the decline, showing resilience with stable income levels, despite some fluctuations.

Potential Pandemic Impact (2020): The fluctuations in 2020 could be linked to COVID-19 disruptions, affecting demand but eventually leading to a recovery phase.

Calculating Average of total business value for each month

[64]:

```
#Calculating Average of total business value for each month
business_value_trend = df.groupby("Month")["Total Business Value"].mean()

# line plot
plt.figure(figsize=(12, 5))
plt.plot(business_value_trend, marker="o", linestyle="-", color="r", label="Total Business Value")
plt.xlabel("Month")
plt.ylabel("Total Business Value")
plt.title("Business Value Acquired Over Time")
plt.legend()
plt.show()
```



Insights-

Fluctuating Business Trends – Business value shows significant ups and downs, indicating variability in performance across months.

Notable Spikes in 2019 & 2020 – Sharp increases in business value suggest the impact of special events, promotions, or seasonal demand.

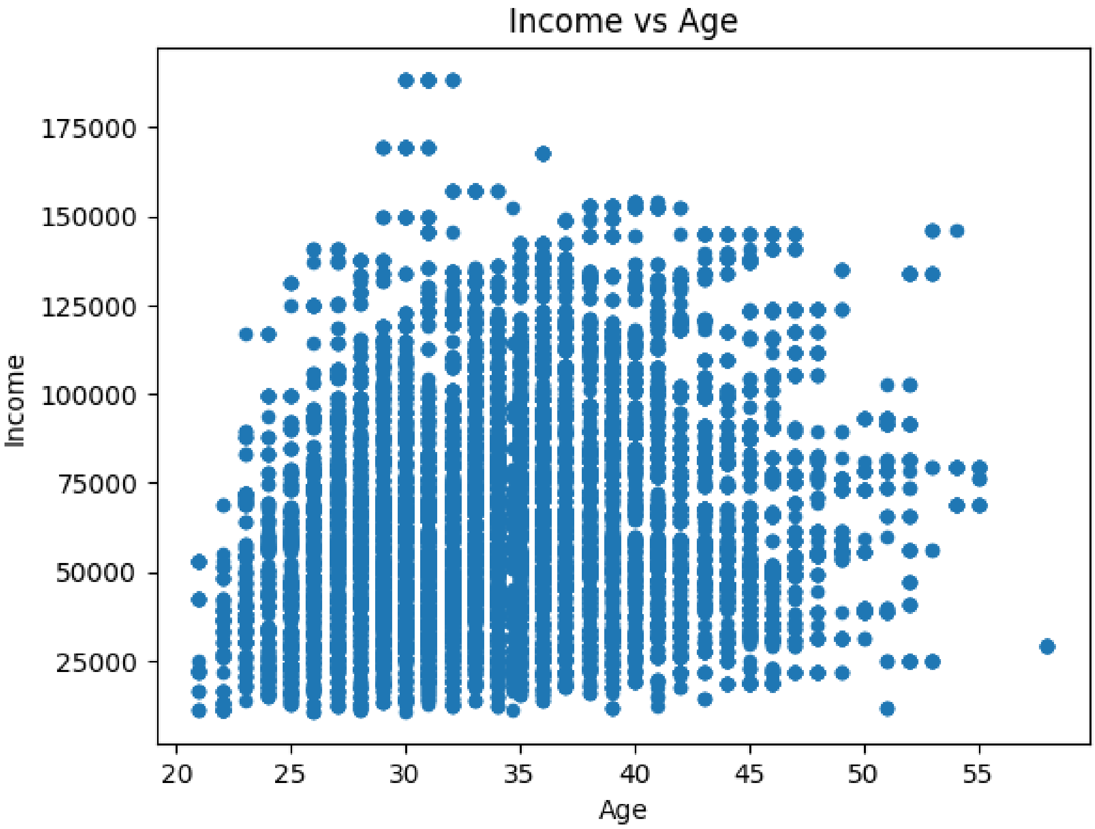
Sudden Declines Post-Growth – Rapid drops following peak months indicate that growth was not sustained over time.

Gradual Recovery Over Time – After declines, business value shows a slow yet steady improvement, though not reaching previous peak levels.

Is there a correlation between Age and Income?

[65] :

```
#Is there a correlation between Age and Income?
df.plot.scatter(x="Age",y="Income",title="Income vs Age")
plt.show()
```



Insights-

Income Grows with Experience – Most people earn more between ages 30 to 45, likely as they gain experience and move up in their careers.

More Variation in Income at Older Ages – After 40, some people earn a lot while others earn much less, possibly due to different career paths, promotions, or industry shifts.

Lower Earnings in the Early Career Stage – People in their 20s generally earn less since they are just starting their careers and working in entry-level roles.

No Fixed Pattern Between Age and Income – Income doesn't just go up with age—other factors like job type, industry, and skills matter a lot too.

How do Education_Level affect Total Business Value?

[66]:
```python
#How do Education_Level and City affect Total Business Value?
education_impact_on_business_value = df.groupby("Education_Level")["Total Business Value"].mean().sort_values(ascending=False)
education_impact_on_business_value
```

[66]:
```
Education_Level
1    601287.867133
0    565410.657872
2    545364.175755
Name: Total Business Value, dtype: float64
```

Insights-

Higher Education Tends to Drive More Business Value-Individuals with Education Level 1 have the highest average total business value (601,288), followed by Level 0 (565,410), and Level 2 (545,364).

How do City affect Total Business Value?

[67]:
```python
#How do Education_Level and City affect Total Business Value?
city_impact_on_business_value = df.groupby("City")["Total Business Value"].mean().sort_values(ascending=False)
city_impact_on_business_value
```

[67]:
```
City
C13    796263.075571
C29    736637.511111
C12    667282.310867
C26    661837.445339
C5     634855.975610
C16    632585.712271
C19    630978.151986
C14    607931.635802
C28    591406.778917
C24    584712.426710
C21    572684.776119
C27    572039.312977
C8     566328.539326
C6     566042.954545
C22    559749.431397
C4     556092.266436
C2     553365.084746
C15    553266.636005
C18    550106.250000
C10    540753.736559
C11    538549.145299
C1     531560.280650
C25    507575.119863
C7     484569.228243
C20    468535.605159
```

```
C9     467914.865385
C3     458003.940345
C17    429160.204545
C23    423986.561338
Name: Total Business Value, dtype: float64
```

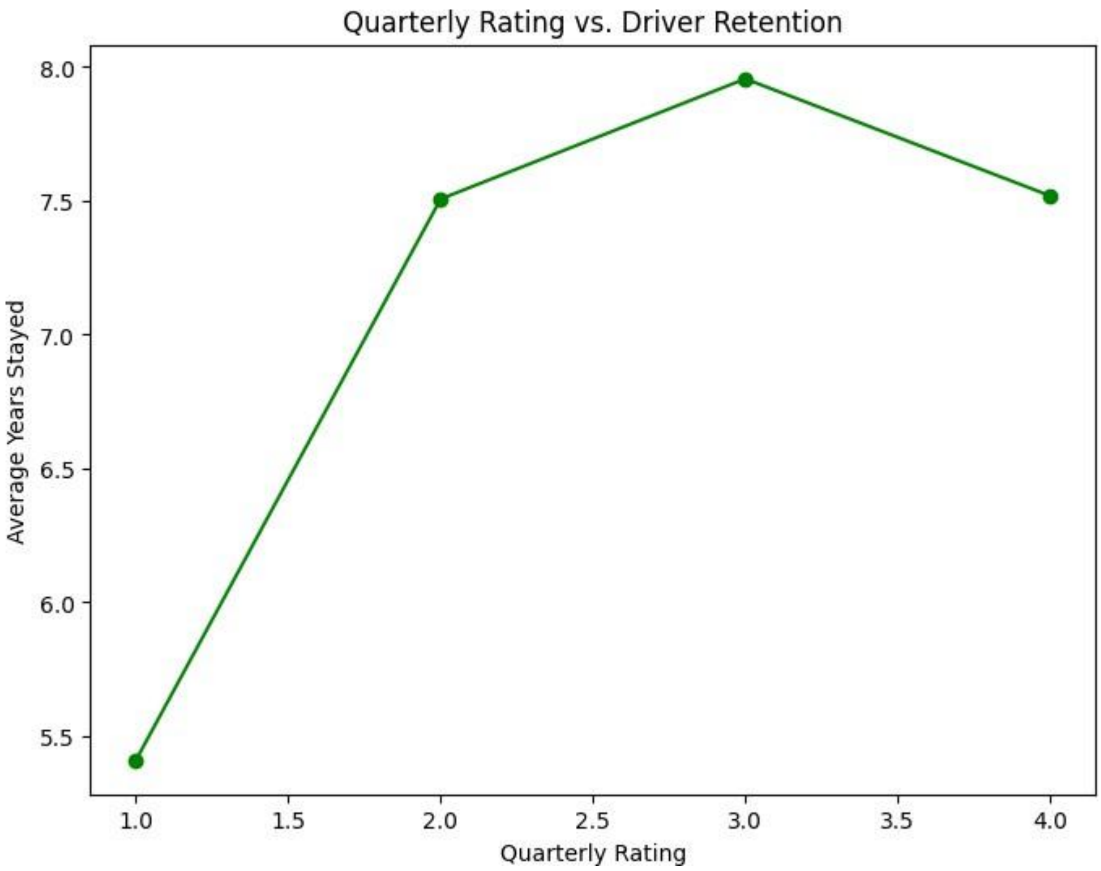
Insights-

Different cities contribute significantly different average total business values, indicating that location plays a crucial role in business performance.

Are drivers with higher Quarterly Rating more likely to stay longer?

[70]:
```python
#Are drivers with higher Quarterly Rating more likely to stay longer?

# Converting dates to datetime format
df["Dateofjoining"] = pd.to_datetime(df["Dateofjoining"])
df["LastWorkingDate"] = pd.to_datetime(df["LastWorkingDate"])

# Filling missing LastWorkingDate with today's date
df["LastWorkingDate"].fillna(pd.to_datetime("today"), inplace=True)

# Calculating how many years the driver worked
df["Years Stayed"] = df["LastWorkingDate"].dt.year - df["Dateofjoining"].dt.year

#calculating average years for ach quarter rating
rating_trend = df.groupby("Quarterly Rating")["Years Stayed"].mean()

# line graph
plt.figure(figsize=(8,6))
plt.plot(rating_trend, marker="o", linestyle="-", color="g")
plt.xlabel("Quarterly Rating")
plt.ylabel("Average Years Stayed")
plt.title("Quarterly Rating vs. Driver Retention")
plt.show()
```

```
<ipython-input-70-ba28a9074b01>:8: FutureWarning: A value is trying to be set on
a copy of a DataFrame or Series through chained assignment using an inplace
method.
The behavior will change in pandas 3.0. This inplace method will never work
because the intermediate object on which we are setting values always behaves as
a copy.

For example, when doing 'df[col].method(value, inplace=True)', try using
'df.method({col: value}, inplace=True)' or df[col] = df[col].method(value)
instead, to perform the operation inplace on the original object.


  df["LastWorkingDate"].fillna(pd.to_datetime("today"), inplace=True)
```



Insights-

The plot indicates that as the Quarterly Rating increases from 1 to 3, the Average Years Stayed also increases.

This suggests that drivers with higher ratings tend to stay longer, which makes sense as high-rated drivers may be more engaged, satisfied, or financially stable.

Interestingly, the trend declines at Rating 4, meaning drivers with the highest rating are leaving earlier than those with a rating of 3.

Highly-rated drivers might get better opportunities elsewhere.

Based on the analysis, what strategies can Ola implement to improve driver retention?

1. Ola should focus on increasing driver income, particularly for those earning in the 50,000 - 75,000 range, as many drivers leave for better pay
2. They should Implement performance-based incentives or bonuses to motivate drivers and increase their earning potential.

Are there specific demographic groups or performance metrics that require targeted interventions?

1. Drivers in the 30-40 age group represent the majority and should be a primary focus for retention strategies
2. Drivers earning in the 50,000 - 75,000 range may be more likely to seek alternative opportunities, so targeted interventions to increase their income are crucial
3. Drivers with consistently high Total Business Value are valuable assets and should be incentivized to stay with Ola.

Identify key factors influencing driver attrition.

1. Many drivers feel they're not making enough money due to reduced fares and high commission fees. If they can't cover their costs and make a decent living, they'll look for better opportunities elsewhere.
2. A single low rating or an unfair complaint can hurt a driver's standing on the platform, making it harder for them to get rides and earn money. Many feel this system is stacked against them.
3. Other ride-hailing services often offer better bonuses or lower commission cuts. Drivers will naturally move to where they feel more valued and better compensated.

Recommend strategies to improve driver retention.

1. Ensure that drivers are paid fairly, with bonuses for peak-hour work and reduced commission fees so they can actually take home a decent income.
2. Introduce rest periods and encourage work-life balance.
3. The company could focus on understanding why highly-rated drivers leave and implement targeted retention strategies (e.g., better incentives, promotions, or bonuses).
4. Reward drivers based on tenure with perks like lower fees, special discounts, or exclusive offers.
5. Develop retention programs specifically for drivers in the 30-40 age group, as they form the majority of the driver base
6. Allow drivers to choose shifts that better fit their personal lives. Avoid forcing excessive hours.