Project Description

```
# 🚗 Car Sales & Company Revenue Analysis Project

# This project analyzes a car sales dataset to uncover insights about customers, dealers, and car companiesb.
# The main goals are:
# - Understand customer demographics (income, gender, regions).
# - Analyze dealers activity and distribution across regions.
# - Analyze Companies' Total Sales and Revenue
# - Identify patterns that can help with sales and marketing strategies.
# - Explore car selling trends such as body style, color, engine type, model and manufacturer.
```

```
# ## 📂 Dataset Overview
# The dataset includes:
# - Customer details: Name, Gender, Annual Income.
# - Dealer details: Dealer Name, Dealer No., Dealer Region.
# - Car company details: Company name, Sales, Revenue.
```

Data Import and Overview

2]:
```
# Load Dataset
cars = pd.read_csv("Car Sales.xlsx - car_data.csv")

# view dataset
cars.head(10)
```

2]:

	Car_id	Date	Month	Customer Name	Gender	Annual Income	Dealer_Name	Company	Model	Engine	Transmission	Color	Price ($)	Dealer_No	
0	C_CND_000001	1/2/2022	1	Geraldine	Male	13500	Buddy Storbeck's Diesel Service Inc	Ford	Expedition	DoubleÂ Overhead Camshaft	Auto	Black	$26,000	06457-3834	
1	C_CND_000002	1/2/2022	1	Gia	Male	1480000	C & M Motors Inc	Dodge	Durango	DoubleÂ Overhead Camshaft	Auto	Black	$19,000	60504-7114	
2	C_CND_000003	1/2/2022	1	Gianna	Male	1035000	Capitol KIA	Cadillac	Eldorado	Overhead Camshaft	Manual	Red	$31,500	38701-8047	Pas
3	C_CND_000004	1/2/2022	1	Giselle	Male	13500	Chrysler of Tri-Cities	Toyota	Celica	Overhead Camshaft	Manual	Pale White	$14,000	99301-3882	
4	C_CND_000005	1/2/2022	1	Grace	Male	1465000	Chrysler Plymouth	Acura	TL	DoubleÂ Overhead Camshaft	Auto	Red	$24,500	53546-9427	Hat
5	C_CND_000006	1/2/2022	1	Guadalupe	Male	850000	Classic Chevy	Mitsubishi	Diamante	Overhead Camshaft	Manual	Pale White	$12,000	85257-3102	Hat
6	C_CND_000007	1/2/2022	1	Hailey	Male	1600000	Clay Johnson Auto Sales	Toyota	Corolla	Overhead Camshaft	Manual	Pale White	$14,000	78758-7841	Pas
7	C_CND_000008	1/2/2022	1	Graham	Male	13500	U-Haul CO	Mitsubishi	Galant	DoubleÂ Overhead Camshaft	Auto	Pale White	$42,000	78758-7841	Pas
8	C_CND_000009	1/2/2022	1	Naomi	Male	815000	Rabun Used Car Sales	Chevrolet	Malibu	Overhead Camshaft	Manual	Pale White	$82,000	85257-3102	H
9	C_CND_000010	1/2/2022	1	Grayson	Female	13500	Rabun Used Car Sales	Ford	Escort	DoubleÂ Overhead Camshaft	Auto	Pale White	$15,000	85257-3102	Pas

Data Description

```
# Understand the structure of the dataset
print(cars.info())
print("--------------------")
print(cars.describe())
print("--------------------")
print(cars.nunique())
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 23906 entries, 0 to 23905
Data columns (total 17 columns):
 #   Column         Non-Null Count  Dtype 
---  ------         --------------  ----- 
 0   Car_id         23906 non-null  object
 1   Date           23906 non-null  object
 2   Month          23906 non-null  int64 
 3   Customer Name  23905 non-null  object
 4   Gender         23906 non-null  object
 5   Annual Income  23906 non-null  int64 
 6   Dealer_Name    23906 non-null  object
 7   Company        23906 non-null  object
 8   Model          23906 non-null  object
 9   Engine         23906 non-null  object
 10  Transmission   23906 non-null  object
 11  Color          23906 non-null  object
 12  Price ($)      23906 non-null  object
 13  Dealer_No      23906 non-null  object
 14  Body Style     23906 non-null  object
 15  Phone          23906 non-null  int64 
 16  Dealer_Region  23906 non-null  object
dtypes: int64(3), object(14)
memory usage: 3.1+ MB
None
--------------------
              Month  Annual Income         Phone
count  23906.000000   2.390600e+04  2.390680e+04
mean       7.852924   8.308403e+05  7.497741e+06
std        3.257985   7.200864e+05  8.674928e+05
min        1.000000   1.008800e+04  6.000181e+06
25%        5.000000   3.860000e+05  6.746495e+06
50%        9.000000   7.350000e+05  7.496198e+06
75%       11.000000   1.175750e+06  8.248146e+06
max       12.000000   1.120000e+07  8.999579e+06
--------------------
Car_id           23906
Date               612
Month               12
Customer Name     3021
Gender               2
Annual Income     2508
Dealer_Name         28
Company             38
Model              154
Engine               2
Transmission         2
Color                3
Price ($)          870
Dealer_No            7
Body Style           5
Phone            23804
Dealer_Region        7
dtype: int64
```

Data Cleaning

Missing Values and Duplicates

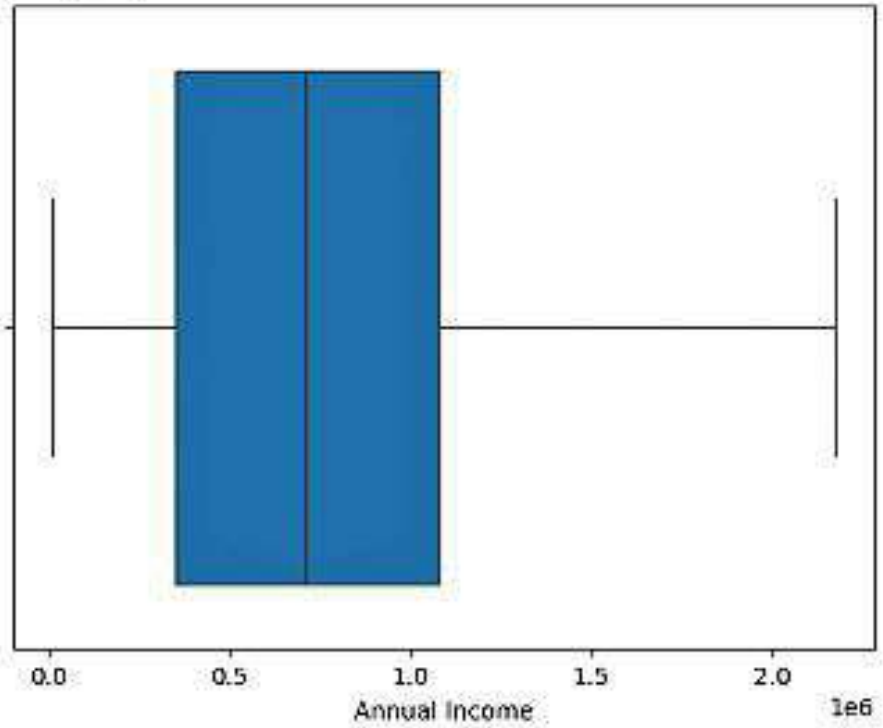
```
# Data Cleaning
# [1] Drop NA's:
cars.isna().sum()
cars.dropna(inplace= True)

# [2] Remove Duplicates:
cars.duplicated().sum() # No duplicates
```

```
np.int64(0)
```

Removing Outliers

```
# Checking for Outliers in Annual Income

# sns.boxplot(x=cars["Annual Income"])   # Their are outliers
# plt.show()

# Removing Outliers in cars dataset
q1 = cars['Annual Income'].quantile(0.25)
q3 = cars['Annual Income'].quantile(0.75)
iqr = q3 - q1

lowerBounds = q1 - 1.5*iqr
upperBounds = q3 + 1.5*iqr

cars = cars[(cars['Annual Income'] >= lowerBounds) & (cars['Annual Income'] <= upperBounds)]
print(cars.shape)

sns.boxplot(x=cars["Annual Income"])   # outliers removed
plt.show()
```

```
(22806, 17)
```



Checking No Outliers

```
remaining_outliers = cars[
    (cars['Annual Income'] < lowerBounds) |
    (cars['Annual Income'] > upperBounds)
]

print(f"Number of remaining outliers: {len(remaining_outliers)}")
```

```
Number of remaining outliers: 0
```

Fixing some Datatypes and fomat

```
# Fixing Some DataTypes
# [1] Convert Date column from object datatype to datetime
cars['Date'] = pd.to_datetime(cars['Date'], errors= 'coerce')

# [2] Clean Price column like removing $ and , and convert it to float
cars['Price ($)'] = cars['Price ($)'].replace(r'[\$,]', '', regex= True).astype(float)

print(cars.info())
```

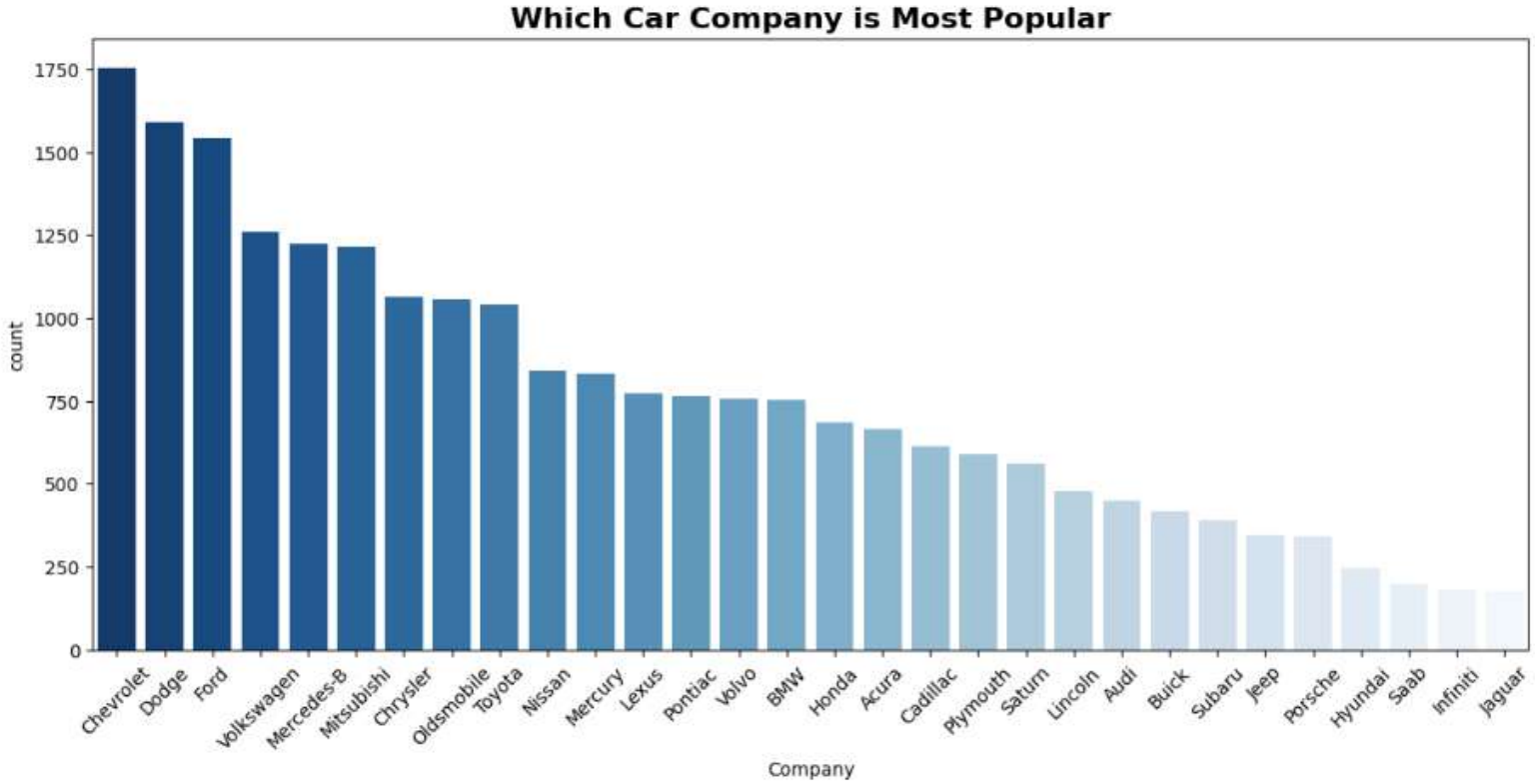
```
<class 'pandas.core.frame.DataFrame'>
Index: 22806 entries, 0 to 23905
Data columns (total 17 columns):
 #   Column         Non-Null Count  Dtype
---  ------         --------------  -----
 0   Car_id         22806 non-null  object
 1   Date           22806 non-null  datetime64[ns]
 2   Month          22806 non-null  int64
 3   Customer Name  22806 non-null  object
 4   Gender         22806 non-null  object
 5   Annual Income  22806 non-null  int64
 6   Dealer_Name    22806 non-null  object
 7   Company        22806 non-null  object
 8   Model          22806 non-null  object
 9   Engine         22806 non-null  object
 10  Transmission   22806 non-null  object
 11  Color          22806 non-null  object
 12  Price ($)      22806 non-null  float64
 13  Dealer_No      22806 non-null  object
 14  Body Style     22806 non-null  object
 15  Phone          22806 non-null  int64
 16  Dealer_Region  22806 non-null  object
dtypes: datetime64[ns](1), float64(1), int64(3), object(12)
memory usage: 3.1+ MB
None
```

Cars Company Analysis

```
CompanyCount = cars['Company'].value_counts()
print(CompanyCount)
```

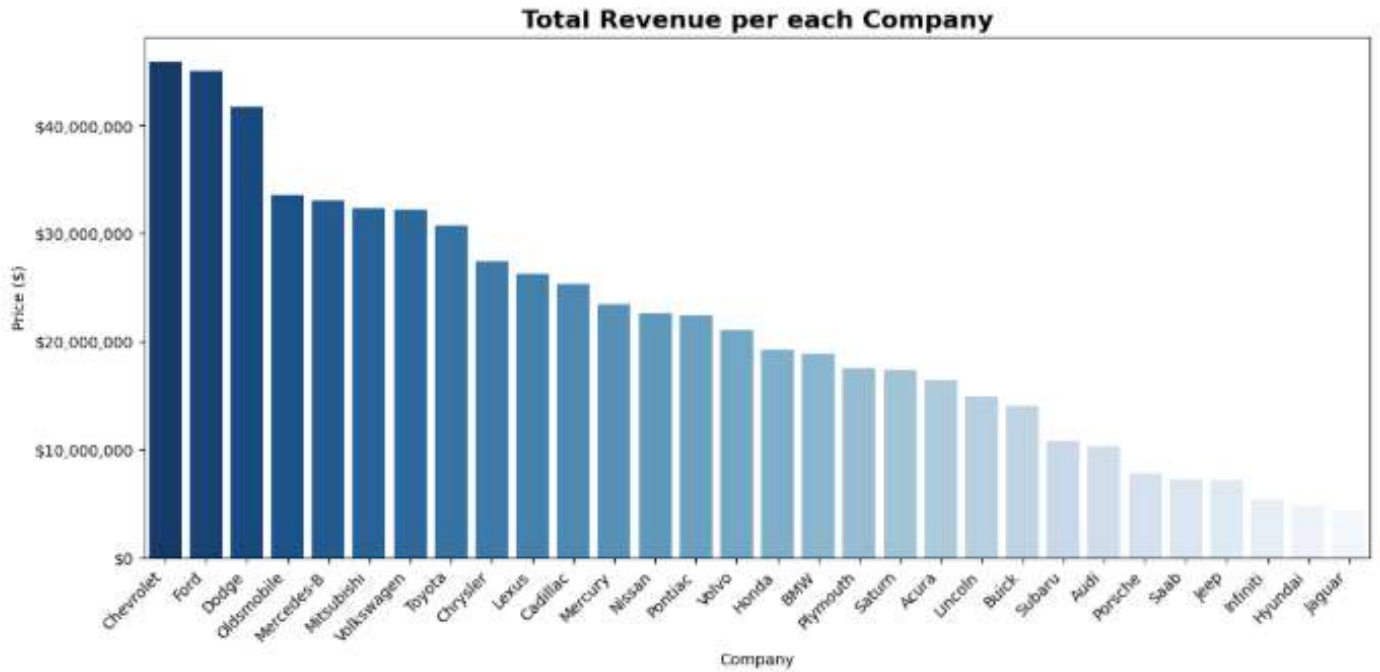
```
Company
Chevrolet     1755
Dodge         1590
Ford          1543
Volkswagen    1260
Mercedes-B    1225
Mitsubishi    1216
Chrysler      1062
Oldsmobile    1056
Toyota        1041
Nissan         839
Mercury        831
Lexus          773
Pontiac        766
Volvo          757
BMW            751
Honda          687
Acura          664
Cadillac       614
Plymouth       590
Saturn         561
Lincoln        476
Audi           449
Buick          419
Subaru         389
Jeep           346
Porsche        343
Hyundai        245
Saab           200
Infiniti       183
Jaguar         175
Name: count, dtype: int64
```

```
CompanyCount = cars['Company'].value_counts().index
# print(CompanyCount)

colors = sns.color_palette("Blues_r", len(CompanyCount))

plt.figure(figsize=(14,6))
sns.countplot(
    data= cars,
    x= "Company",
    order= CompanyCount,
    hue= "Company",          # required to be future-proof
    hue_order= CompanyCount,        # make hue follow the same order as x
    palette= colors,         # gradient aligns with order
    dodge= False,            # keep one bar per category
    legend= False
)

plt.title("Which Car Company is Most Popular", fontsize=16, fontweight='bold')
plt.xticks(rotation=45)
plt.show()
```

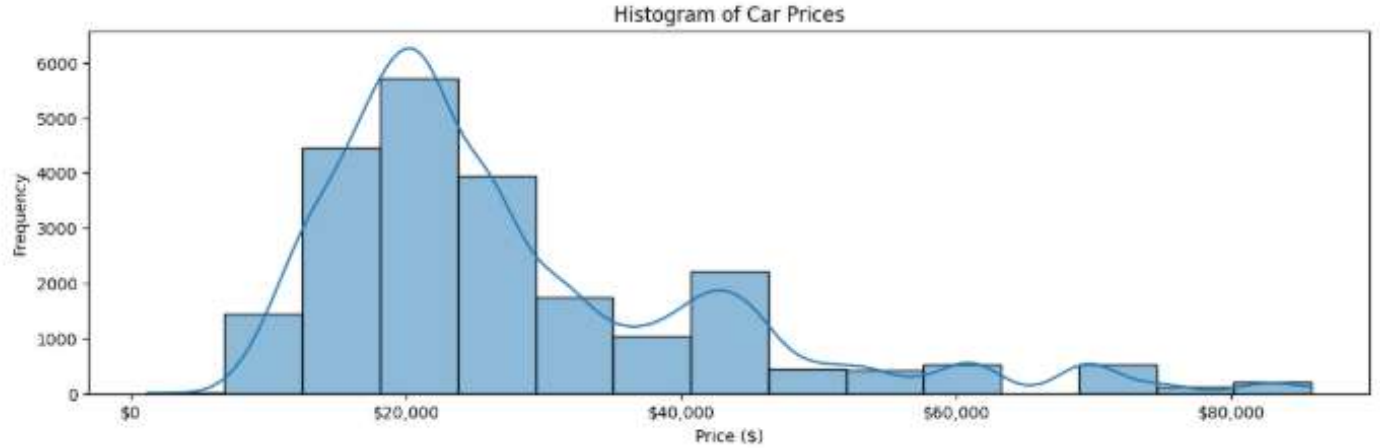


```
# Which Company has the highest Revenue
companyTotalSales = cars.groupby('Company')['Price ($)'].sum().sort_values(ascending= False)
print(companyTotalSales)

companyTotalSales = pd.DataFrame(companyTotalSales)
plt.figure(figsize=(14, 6))
sns.barplot(x='Company',
            y= 'Price ($)',
            data=companyTotalSales,
            palette= colors)

# Format y-axis with dollar sign and commas
plt.gca().yaxis.set_major_formatter(mtick.StrMethodFormatter('${x:,.0f}'))
plt.xticks(rotation= 45, ha= 'right')
plt.title("Total Revenue per each Company", fontsize=16, fontweight='bold')
plt.show()
```

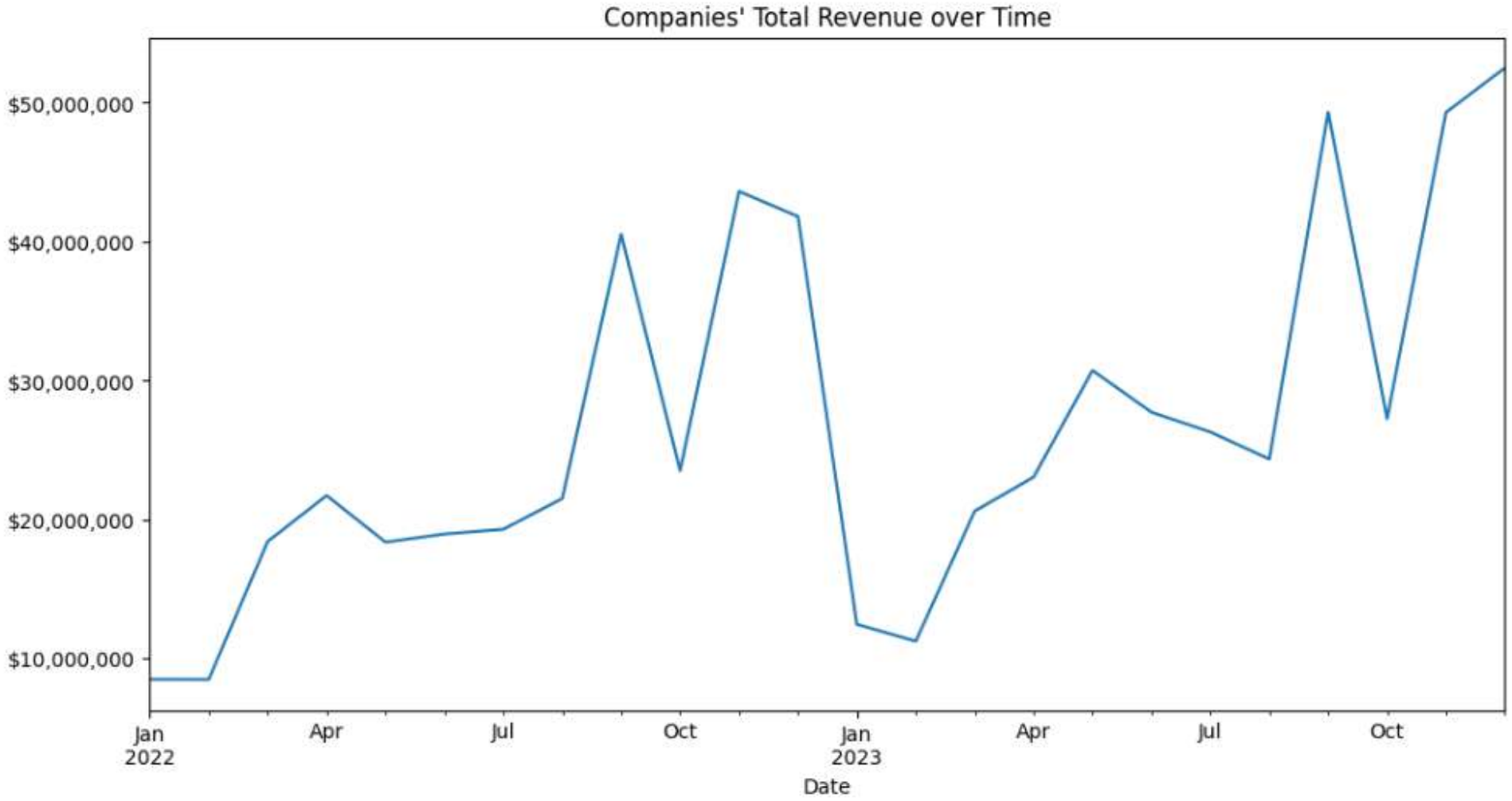
```
Company
Chevrolet     45918744.0
Ford          45059313.0
Dodge         41749977.0
Oldsmobile    33559413.0
Mercedes-B    33029850.0
Mitsubishi    32337249.0
Volkswagen    32223761.0
Toyota        30729344.0
Chrysler      27443106.0
Lexus         26288091.0
Cadillac      25363895.0
Mercury       23472219.0
Nissan        22634379.0
Pontiac       22410600.0
Volvo         21050992.0
Honda         19267233.0
BMW           18846480.0
Plymouth      17485466.0
Saturn        17415963.0
Acura         16483740.0
Lincoln       14870059.0
Buick         14103531.0
Subaru        10856989.0
Audi          10267633.0
Porsche        7756628.0
Saab           7308177.0
Jeep           7174961.0
Infiniti       5373036.0
Hyundai        4734961.0
Jaguar         4425874.0
Name: Price ($), dtype: float64
```



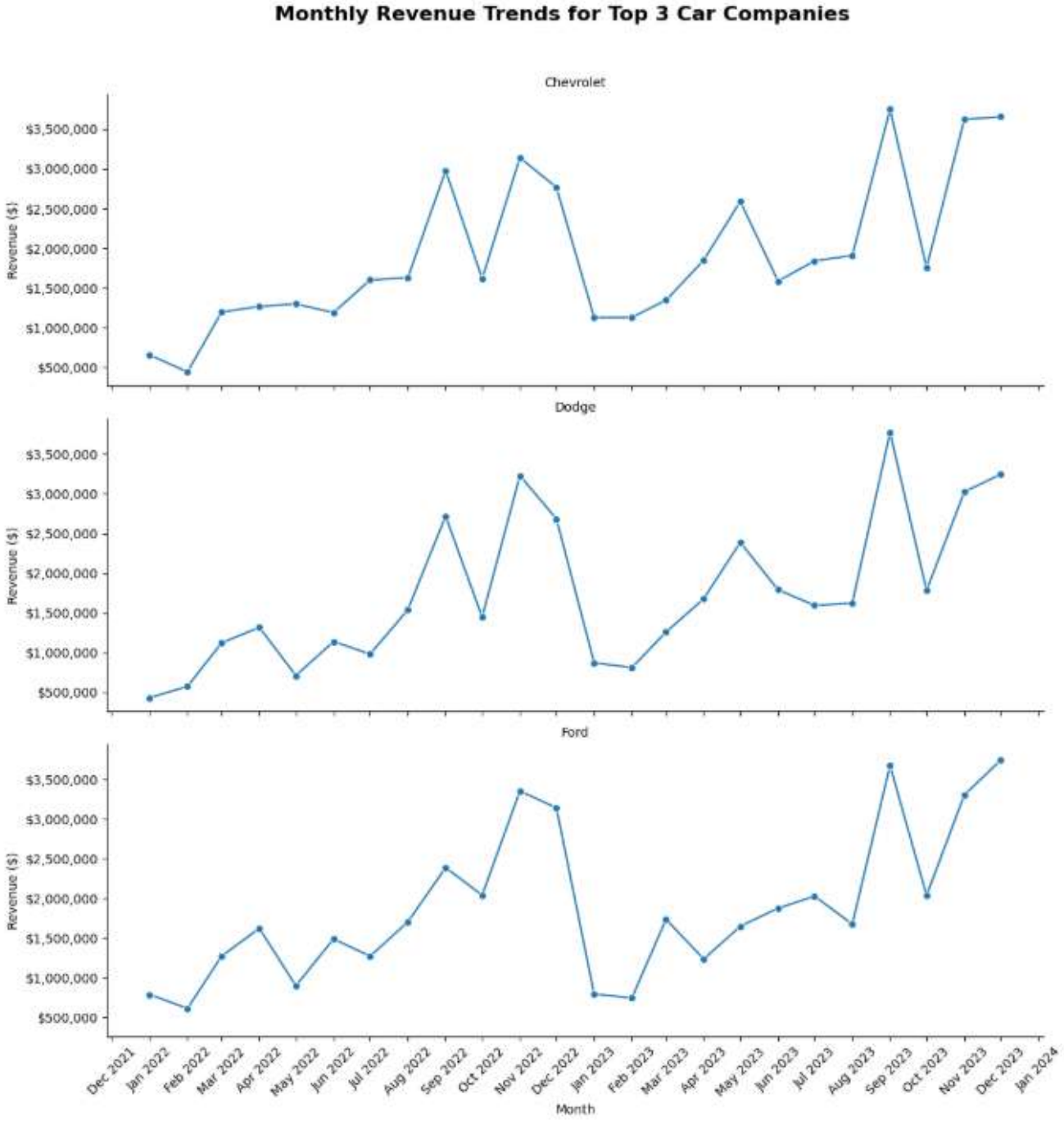

```
# Univariate analysis
# Analyze numeric column using histograms
plt.figure(figsize=(14, 4))  # width=10, height=6 inches
sns.histplot(cars['Price ($)'], kde=True, bins= 15)
plt.title('Histogram of Car Prices')
plt.xlabel('Price ($)')
plt.ylabel('Frequency')
plt.gca().xaxis.set_major_formatter(mtick.StrMethodFormatter('${x:,.0f}'))
plt.show()
```



```
# Time based analysis
salesOverTime = cars.groupby(cars['Date'].dt.to_period('M'))['Price ($)'].sum()
# print(salesOverTime)
plt.figure(figsize=(12, 6))
salesOverTime.plot(kind= 'line')
plt.title("Companies' Total Revenue over Time")
# Format y-axis with dollar sign and commas
plt.gca().yaxis.set_major_formatter(mtick.StrMethodFormatter('${x:,.0f}'))
plt.show()
```

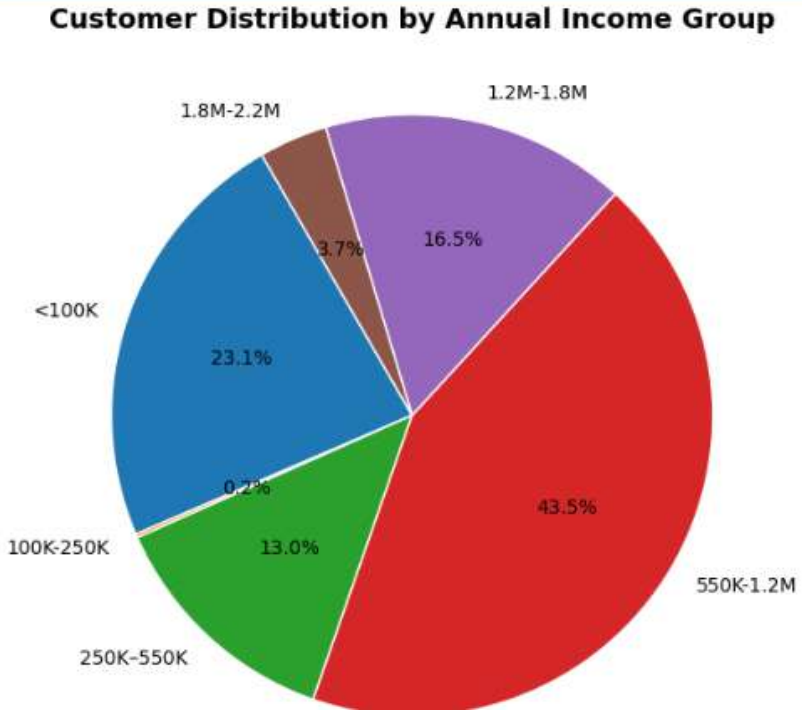


```
import matplotlib.dates as mdates

# Convert Date
cars['Date'] = pd.to_datetime(cars['Date'])
cars['YearMonth'] = cars['Date'].dt.to_period('M').dt.to_timestamp()

# Top 3 companies by total revenue
top_companies = (
    cars.groupby('Company')['Price ($)']
    .sum()
    .sort_values(ascending=False)
    .head(3)
    .index
)

# print(top_companies)

# Filter dataset to only top companies
cars_top = cars[cars['Company'].isin(top_companies)]

# Aggregate revenue per month per company
monthly_revenue = (
    cars_top.groupby(['YearMonth','Company'])['Price ($)']
    .sum()
    .reset_index()
)

g = sns.relplot(
    data=monthly_revenue,
    x="YearMonth",
    y="Price ($)",
    kind="line",
    col="Company",
    col_wrap=1,       # wrap into multiple rows
    height=4,
    aspect=2.8,
    marker="o"
)

g.set_titles("{col_name}", fontweight='light')
g.set_axis_labels("Month", "Revenue ($)")
plt.subplots_adjust(top=0.9)
g.fig.suptitle("Monthly Revenue Trends for Top 3 Car Companies", fontsize=16, fontweight='bold')
# Formatting the y axis to has $ and ,
plt.gca().yaxis.set_major_formatter(mtick.StrMethodFormatter('${x:,.0f}'))  # 2,000,000

# Format x-axis as short month names
for ax in g.axes.flat:
    ax.xaxis.set_major_locator(mdates.MonthLocator(interval=1))  # diplay every month
    ax.xaxis.set_major_formatter(mdates.DateFormatter('%b %Y'))  # e.g., Jan 2022, Feb 2022
    ax.tick_params(axis='x', rotation=45)  # rotate to avoid overlap
plt.show()
```

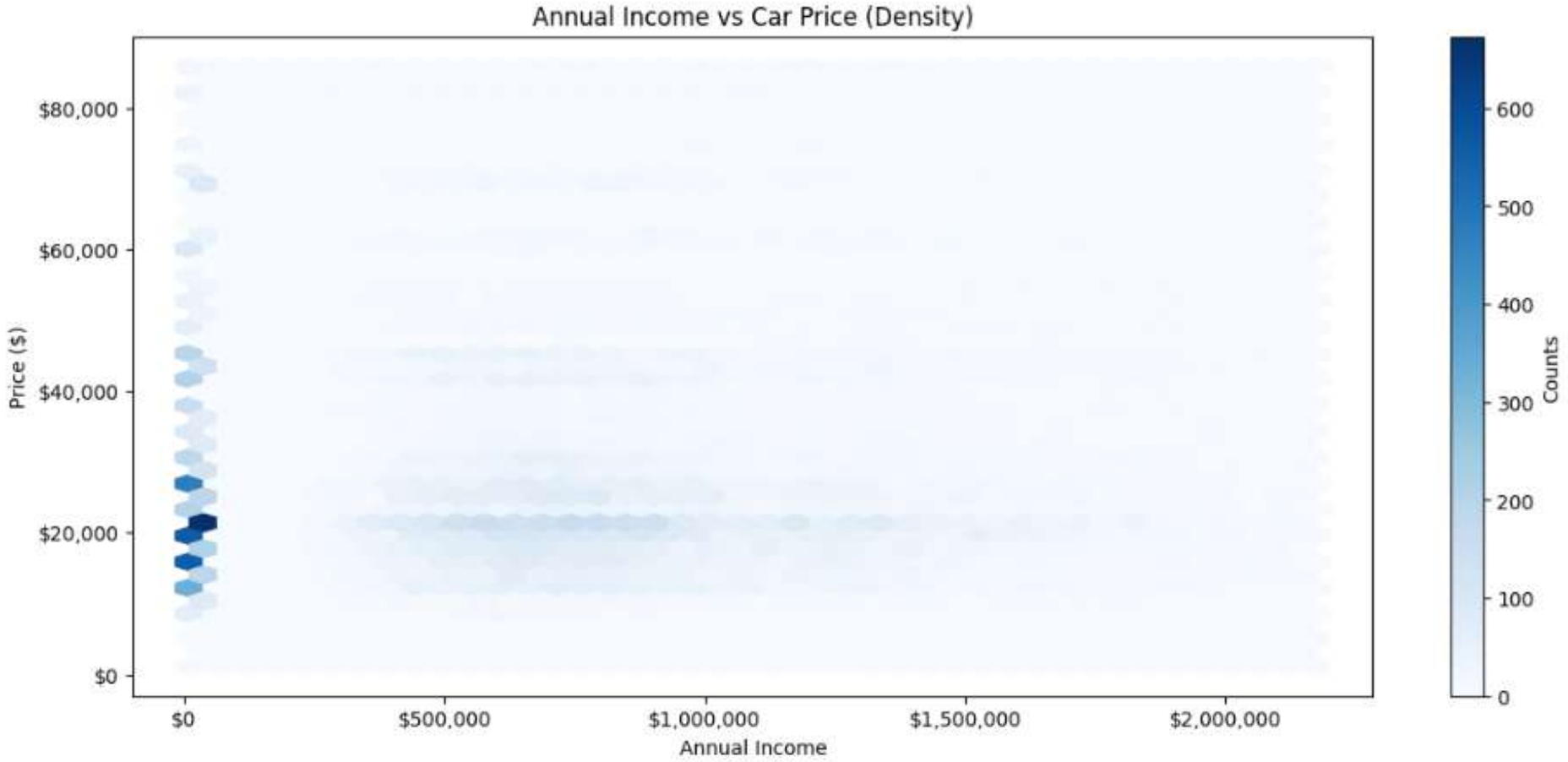

Monthly Revenue Trends for Top 3 Car Companies
Chevrolet
Dodge
Ford
Revenue ($)
$500,000
$1,000,000
$1,500,000
$2,000,000
$2,500,000
$3,000,000
$3,500,000
Dec 2021
Jan 2022
Feb 2022
Mar 2022
Apr 2022
May 2022
Jun 2022
Jul 2022
Aug 2022
Sep 2022
Oct 2022
Nov 2022
Dec 2022
Jan 2023
Feb 2023
Mar 2023
Apr 2023
May 2023
Jun 2023
Jul 2023
Aug 2023
Sep 2023
Oct 2023
Nov 2023
Dec 2023
Jan 2024
Month

Customers Analysis

```
# print(cars['Annual Income'].sort_values(ascending= True))

# cars.head()

# print(cars['Annual Income'].max())
# print(cars['Annual Income'].min())

# Grouping Annual income
IncomeGroups = [0, 100000, 250000, 550000, 1200000, 1800000, cars['Annual Income'].max()]
IncomeLabels = ["<100K", "100K-250K", "250K-550K", "550K-1.2M", "1.2M-1.8M", "1.8M-2.2M"]
cars["Income Group"] = pd.cut(cars["Annual Income"],
                              bins= IncomeGroups,
                              labels= IncomeLabels,
                              include_lowest= True)

incomeCounts = cars["Income Group"].value_counts().sort_index()

plt.figure(figsize=(7,7))
plt.pie(incomeCounts,
        labels= incomeCounts.index,
        autopct='%1.1f%%',
        startangle= 120,
        wedgeprops={'edgecolor': 'white'})
plt.title("Customer Distribution by Annual Income Group",fontweight= "bold", fontsize= 14)
plt.show()
```

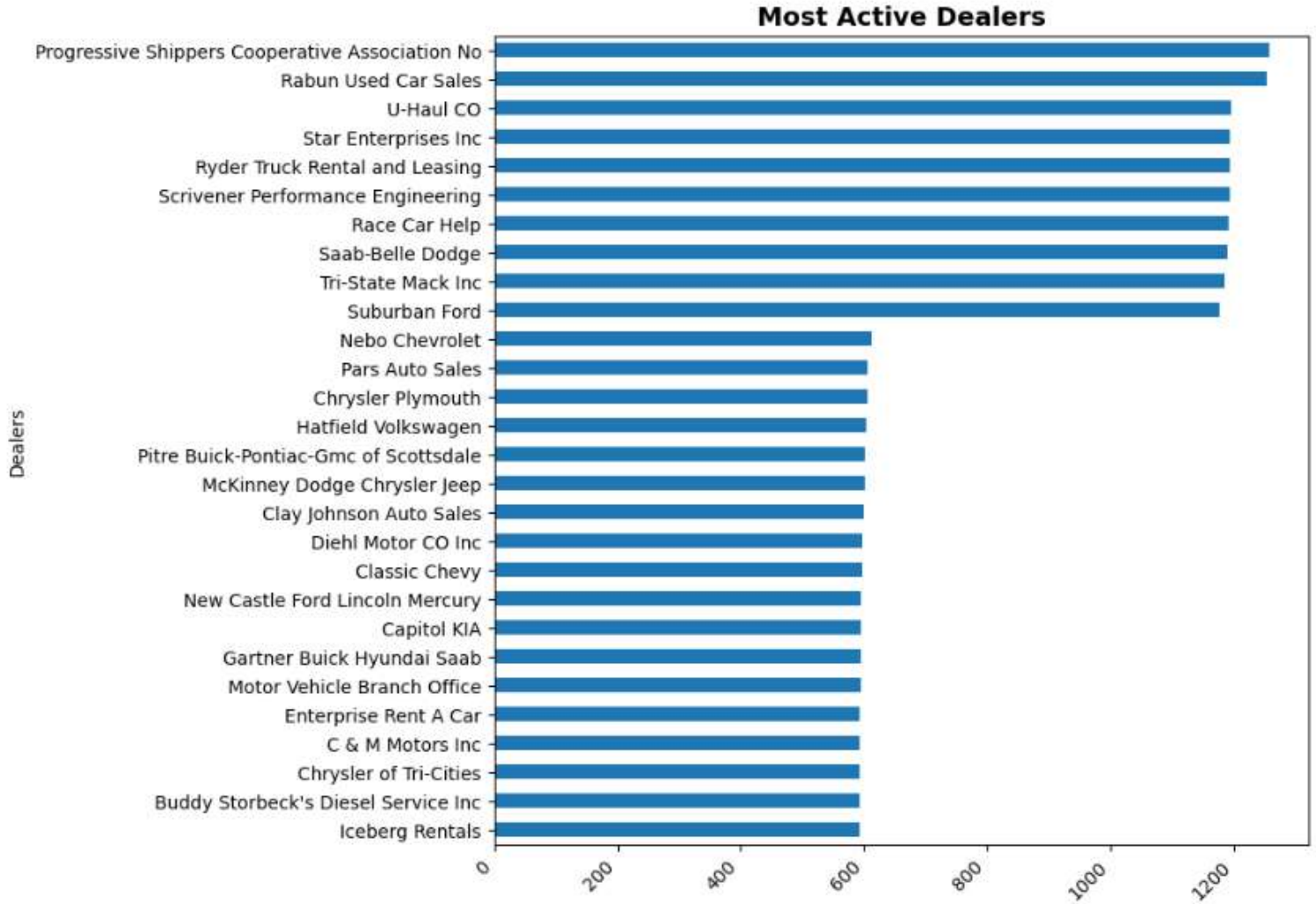


```
]: plt.figure(figsize=(14, 6))
plt.hexbin(cars['Annual Income'], cars['Price ($)'], gridsize=40, cmap="Blues")
plt.colorbar(label="Counts")
plt.xlabel("Annual Income")
plt.ylabel("Price ($)")
plt.title("Annual Income vs Car Price (Density)")
plt.gca().yaxis.set_major_formatter(mtick.StrMethodFormatter('${x:,.0f}'))
plt.gca().xaxis.set_major_formatter(mtick.StrMethodFormatter('${x:,.0f}'))
plt.show()


# Most customers have annual incomes below $1,000,000 and tend to purchase cars priced between $0-$40,000,
# indicating this is the company's primary market segment.
```

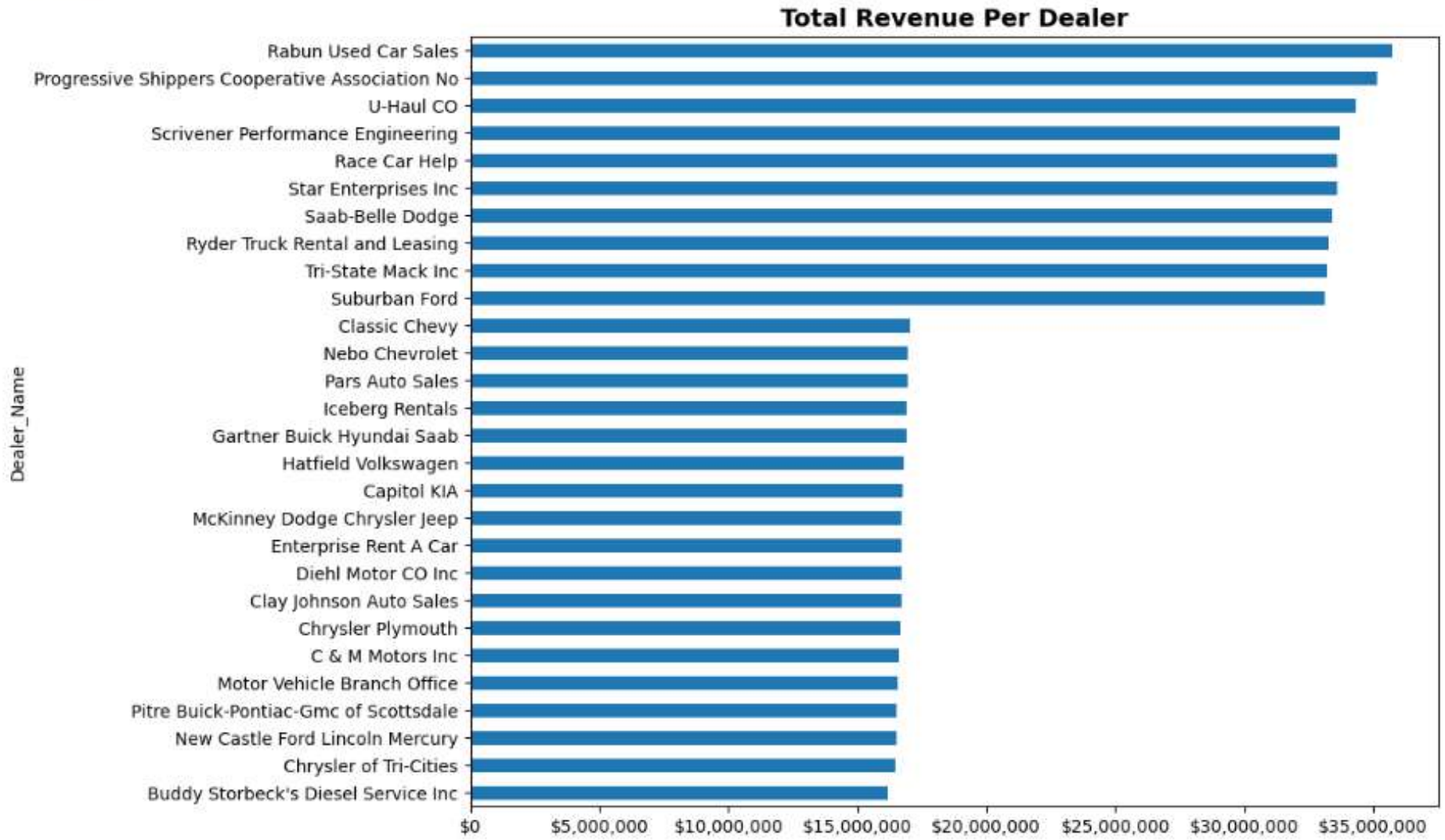


Dealers Analysis

```
Dealer_NameCount = cars['Dealer_Name'].value_counts().sort_values()
# print(Dealer_NameCount)

# print(cars['Dealer_No '].nunique())


Dealer_NameCount.plot(kind= 'barh', figsize= (8, 8))
plt.title("Most Active Dealers", fontsize=14, fontweight='bold')
plt.ylabel('Dealers')
plt.xticks(rotation= 45, ha= 'right')
plt.show()
```



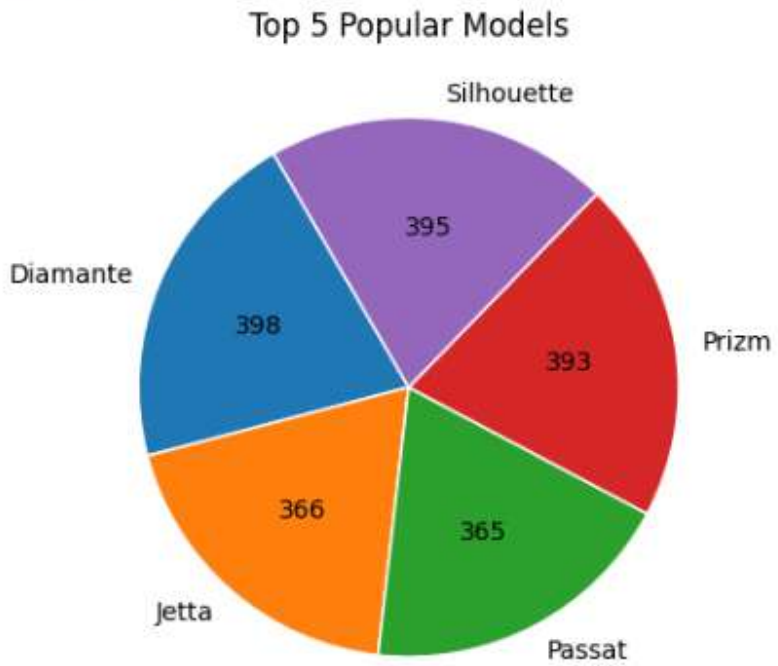
```
: # total Revenue per dealer
dealerRevenue = cars.groupby("Dealer_Name")['Price ($)'].sum().sort_values()

dealerRevenue.plot(kind= "barh", figsize= (10, 8))
plt.title("Total Revenue Per Dealer", fontsize= 14, fontweight= "bold")
plt.gca().xaxis.set_major_formatter(mtick.StrMethodFormatter('${x:,.0f}'))
# plt.xticks(rotation= 45)
plt.show()
```



Cars Manufacturing Analysis

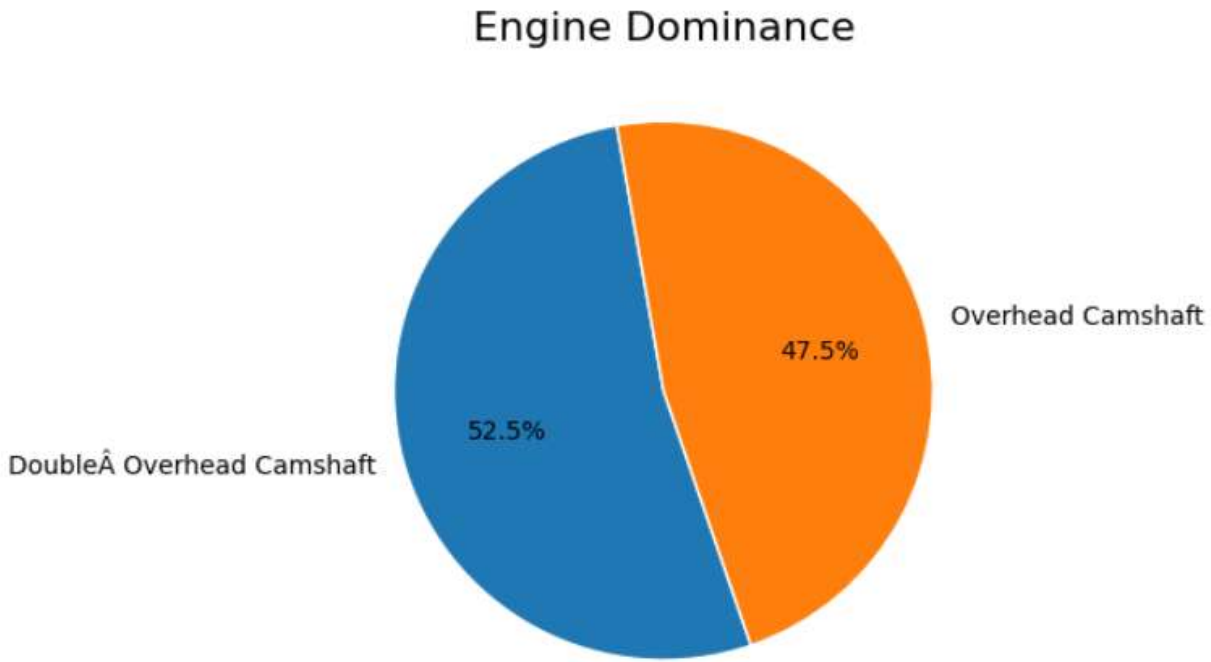
```
ModelTop5 = cars['Model'].value_counts().head(5).sort_index()
print(ModelTop5)


plt.pie(ModelTop5,
        labels= ModelTop5.index,
        autopct=lambda pct: f"{int(round(pct/100.*np.sum(ModelTop5)))}",  # show only count
        startangle= 120,
        wedgeprops={'edgecolor': 'white'})
plt.title("Top 5 Popular Models")
plt.show()
```

```
Model
Diamante      398
Jetta         366
Passat        365
Prizm         393
Silhouette    395
Name: count, dtype: int64
```



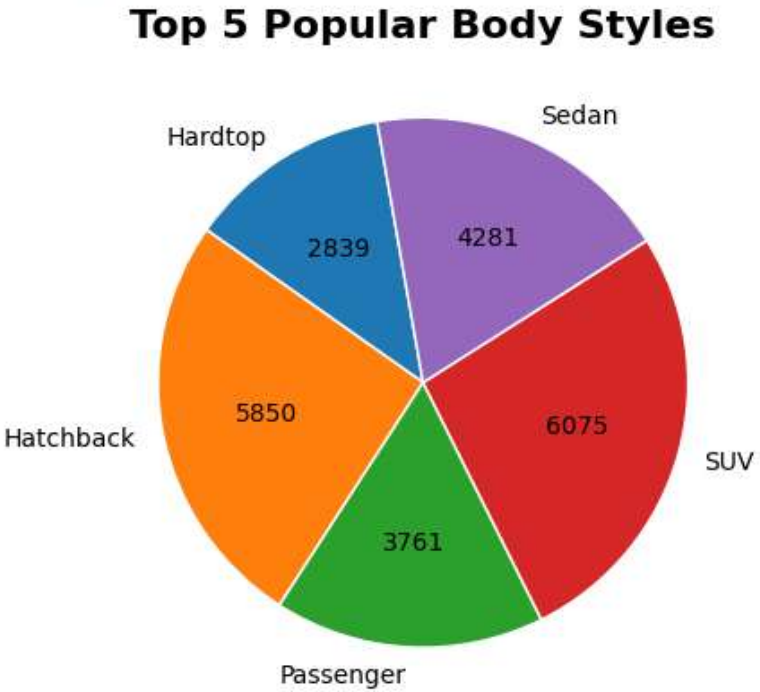
```
EngineCount = cars['Engine'].value_counts().sort_index()
print(EngineCount)   # can be visualized by pie chart

plt.pie(EngineCount,
        labels= EngineCount.index,
        autopct='%1.1f%%',
        startangle= 100,
        wedgeprops={'edgecolor': 'white'})

plt.title("Engine Dominance", fontsize= 16)
plt.show()
```

```
Engine
DoubleÂ Overhead Camshaft    11970
Overhead Camshaft           10836
Name: count, dtype: int64
```



```
BodyStyleCount = cars['Body Style'].value_counts().sort_index()
print(BodyStyleCount)    # can be visualized by pie chart, count plot or column chart


plt.pie(BodyStyleCount,
        labels= BodyStyleCount.index,
        autopct=lambda pct: f"{int(round(pct/100.*np.sum(BodyStyleCount)))}",  # show only count
        startangle= 100,
        wedgeprops={'edgecolor': 'white'})

plt.title("Top 5 Popular Body Styles", fontsize= 16, fontweight= "bold")
plt.show()
```

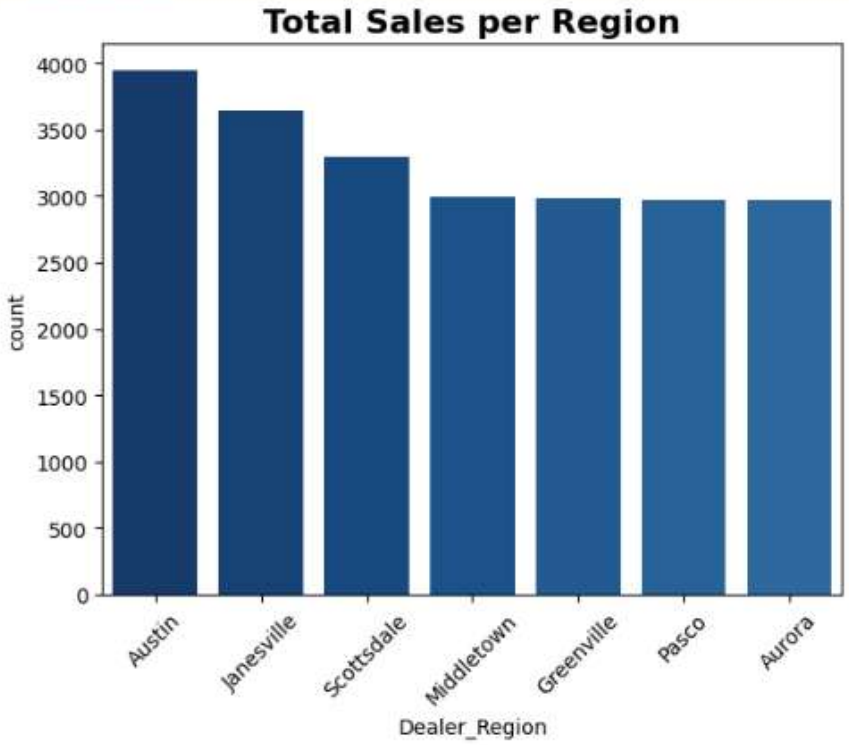
```
Body Style
Hardtop      2839
Hatchback    5850
Passenger    3761
SUV          6075
Sedan        4281
Name: count, dtype: int64
```



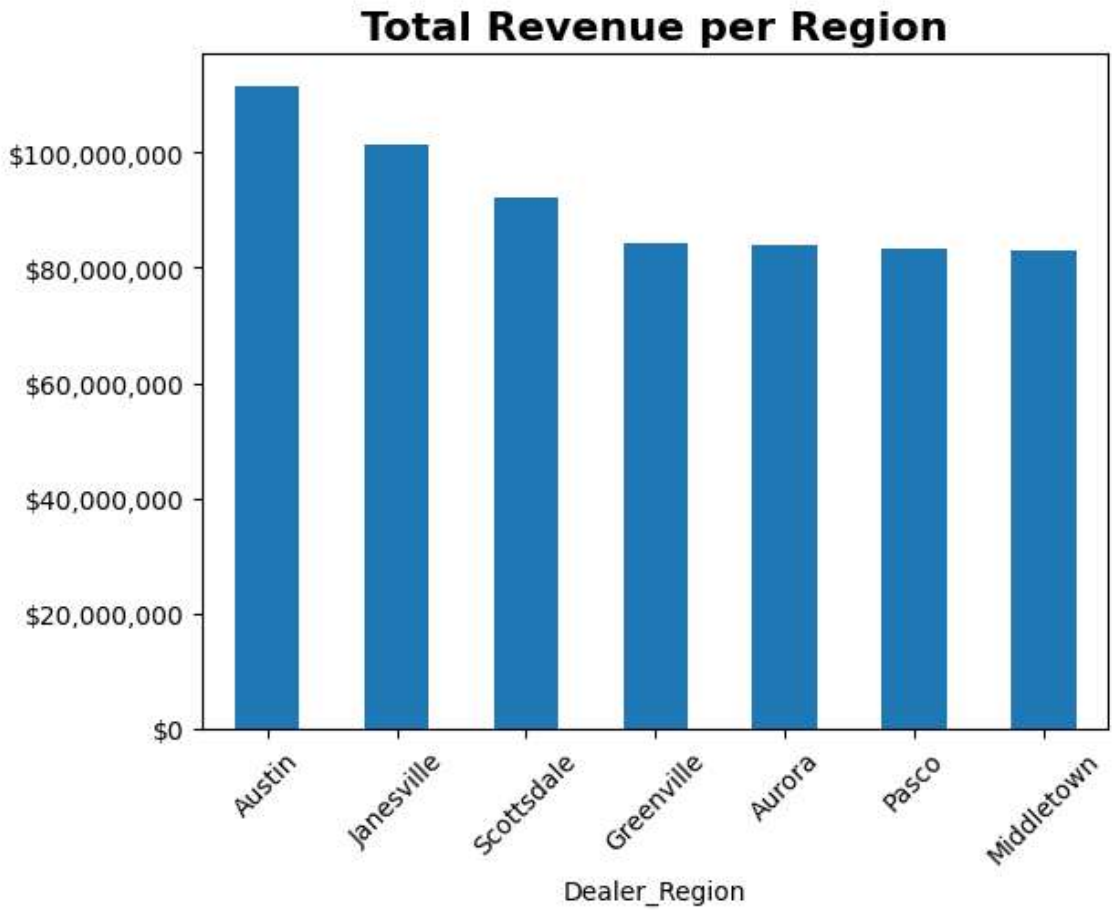
Sales Region Analysis

```
Dealer_RegionCount = cars['Dealer_Region'].value_counts().index
# print(Dealer_RegionCount)    # can be visualized by pie chart, count plot or column chart

colors2 = sns.color_palette("viridis_r", len(Dealer_RegionCount))

sns.countplot(
    data= cars,
    x= "Dealer_Region",
    order= Dealer_RegionCount,
    hue= "Dealer_Region",          # required to be future-proof
    hue_order= Dealer_RegionCount,        # make hue follow the same order as x
    palette= colors,         # gradient aligns with order
    dodge= False,            # keep one bar per category
    legend= False
)

plt.title("Total Sales per Region", fontsize=16, fontweight='bold')
plt.xticks(rotation=45)
plt.show()
```

```
C:\Users\USER\AppData\Local\Temp\ipykernel_13732\1741685511.py:6: UserWarning: The palette list has more values (30) than needed (7), which may not be i
ntended.
  sns.countplot(
```



```
DealerRegionRevenue = cars.groupby('Dealer_Region')['Price ($)'].sum().sort_values(ascending= False)
# print(DealerRegionRevenue)

DealerRegionRevenue.plot(kind= "bar")
plt.title("Total Revenue per Region", fontsize= 16, fontweight= "bold")
plt.gca().yaxis.set_major_formatter(mtick.StrMethodFormatter('${x:,.0f}'))
plt.xticks(rotation=45)
plt.show()
```



]:
```python
# Key metrics summary
print(" KEY BUSINESS METRICS ")
print(f"Total Sales: {len(cars):,}")
print(f"Total Revenue: ${cars['Price ($)'].sum():,.2f}")
print(f"Average Sale Price: ${cars['Price ($)'].mean():,.2f}")
print(f"Highest Price: ${cars['Price ($)'].max():,.2f}")
print(f"Lowest Price: ${cars['Price ($)'].min():,.2f}")
print(f"Average Customer Income: ${cars['Annual Income'].mean():,.2f}")
print(f"Number of Dealers: {cars['Dealer_Name'].nunique()}")
```

```
 KEY BUSINESS METRICS
Total Sales: 22,806
Total Revenue: $639,641,664.00
Average Sale Price: $28,047.08
Highest Sale: $85,800.00
Lowest Sale: $1,200.00
Average Customer Income: $730,858.81
Number of Dealers: 28
```