```python
# 🔹 Step 1: Import Required Libraries
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.impute import SimpleImputer

# 🔹 Step 2: Load the Dataset
file_path = "data.csv"  # Update this if needed
df = pd.read_csv(file_path)

# Display basic information about the dataset
df.info()
df.head()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 19 entries, 0 to 18
Data columns (total 14 columns):
 #   Column    Non-Null Count  Dtype
---  ------    --------------  -----
 0   Category  19 non-null     object
 1   Segment   19 non-null     object
 2   2001-02   18 non-null     float64
 3   2002-03   18 non-null     float64
 4   2003-04   18 non-null     float64
 5   2004-05   18 non-null     float64
 6   2005-06   18 non-null     float64
 7   2006-07   19 non-null     int64
 8   2007-08   19 non-null     int64
 9   2008-09   19 non-null     int64
 10  2009-10   19 non-null     int64
 11  2010-11   12 non-null     float64
 12  2011-12   12 non-null     float64
 13  2012-13   12 non-null     float64
dtypes: float64(8), int64(4), object(2)
memory usage: 2.2+ KB
```

```
                              Category                              Segment
\
0            Passenger Vehicles (PVs)                    Passenger Cars

1            Passenger Vehicles (PVs)           Multi-Utility Vehicles

2            Passenger Vehicles (PVs)  Total Passenger Vehicles (PVs)

3  Commercial Vehicles (CVs) M & HCVs                Passenger Carriers

4  Commercial Vehicles (CVs) M & HCVs                    Goods Carriers


    2001-02   2002-03   2003-04    2004-05    2005-06  2006-07  2007-
```

```
08  \
0  500301.0  557410.0  782562.0   960487.0  1046133.0  1238032
1426212
1  169418.0  165920.0  206998.0   249389.0   263167.0   307202
351371
2  669719.0  723330.0  989560.0  1209876.0  1309300.0  1545234
1777583
3   20283.0   21156.0   27628.0    30419.0    28982.0    32828
46542
4   76469.0   99346.0  138495.0   184388.0   190313.0   261438
248415

   2008-09  2009-10    2010-11    2011-12    2012-13
0  1516967  1932620  2453113.0  2775124.0  2668633.0
1   321626   424791   534183.0   370945.0   564928.0
2  1838593  2357411  2987296.0  3146069.0  3233561.0
3    40995    46026        NaN        NaN        NaN
4   151288   204145        NaN        NaN        NaN
```

```
print("Original Data:")
print(df)
```

```
Original Data:
                              Category
Segment  \
0             Passenger Vehicles (PVs)                    Passenger
Cars
1             Passenger Vehicles (PVs)           Multi-Utility
Vehicles
2             Passenger Vehicles (PVs)   Total Passenger Vehicles
(PVs)
3   Commercial Vehicles (CVs) M & HCVs                Passenger
Carriers
4   Commercial Vehicles (CVs) M & HCVs                   Goods
Carriers
5   Commercial Vehicles (CVs) M & HCVs                   Total M &
HCVs
6                                 LCVs                Passenger
Carriers
7                                 LCVs                   Goods
Carriers
8                                 LCVs                       Total
LCVs
9      Total Commercial Vehicles (CVs)  Total Commercial Vehicles
(CVs)
10                      Three Wheelers                Passenger
Carriers
11                      Three Wheelers                   Goods
Carriers
12                      Three Wheelers             Total Three
```

```
Wheelers
13                          Two wheelers
Scooter/Scooterettee
14                          Two wheelers        Motorcycles/Step-
Throughs
15                          Two wheelers
Mopeds
16                          Two wheelers            Electric Two
Wheelers
17                          Two wheelers               Total Two
wheelers
18                           Grand Total                     Grand
Total

      2001-02    2002-03    2003-04    2004-05    2005-06   2006-07
2007-08  \
0    500301.0   557410.0   782562.0   960487.0  1046133.0   1238032
1426212
1    169418.0   165920.0   206998.0   249389.0   263167.0    307202
351371
2    669719.0   723330.0   989560.0  1209876.0  1309300.0   1545234
1777583
3     20283.0    21156.0    27628.0    30419.0    28982.0     32828
46542
4     76469.0    99346.0   138495.0   184388.0   190313.0    261438
248415
5     96752.0   120502.0   166123.0   214807.0   219295.0    294258
294957
6     14977.0    19821.0    20962.0    22619.0    25395.0     29443
33882
7     50779.0    63374.0    87955.0   116277.0   146393.0    196291
220167
8     65756.0    83195.0   108917.0   138896.0   171788.0    225734
254049
9    162508.0   203697.0   275040.0   353703.0   391083.0    519982
549006
10   170013.0   210454.0   245084.0   237413.0   286987.0    385443
371060
11    42735.0    66265.0   111139.0   137032.0   147436.0    170681
129600
12   212748.0   276719.0   356223.0   374445.0   434423.0    556126
500660
13   937506.0   848434.0   935279.0   987498.0  1021013.0    943974
1074933
14  2906323.0  3876175.0  4355168.0  5193894.0  6207690.0   7112225
6503532
15   427498.0   351612.0   332294.0   348437.0   379994.0    379987
430827
16        NaN        NaN        NaN        NaN        NaN     30454
```

```
17389
17  4271327.0  5076221.0  5622741.0  6529829.0  7608697.0   8466640
8026681
18  5316302.0  6279967.0  7243564.0  8467853.0  9743503.0  11087992
10853930

     2008-09   2009-10     2010-11     2011-12     2012-13
0    1516967   1932620   2453113.0   2775124.0   2668633.0
1     321626    424791    534183.0    370945.0    564928.0
2    1838593   2357411   2987296.0   3146069.0   3233561.0
3      40995     46026         NaN         NaN         NaN
4     151288    204145         NaN         NaN         NaN
5     192283    250133    344542.0    384801.0    278560.0
6      28635     34751         NaN         NaN         NaN
7     195952    281686         NaN         NaN         NaN
8     224587    317423    408193.0    544335.0    553184.0
9     416870    567556    752735.0    929136.0    831744.0
10    417434    530203         NaN         NaN         NaN
11     79586     88890         NaN         NaN         NaN
12    497020    619194    799553.0    879289.0    839742.0
13   1161276   1494409   2144765.0   2659340.0   3025014.0
14   6798118   8444857  10527111.0  11982669.0  11904212.0
15    436219    571070    704575.0    785523.0    791954.0
16     24179      2567         NaN         NaN         NaN
17   8419792  10512903  13376451.0  15427532.0  15721180.0
18  11172275  14057064  17916035.0  20382026.0  20626227.0
```

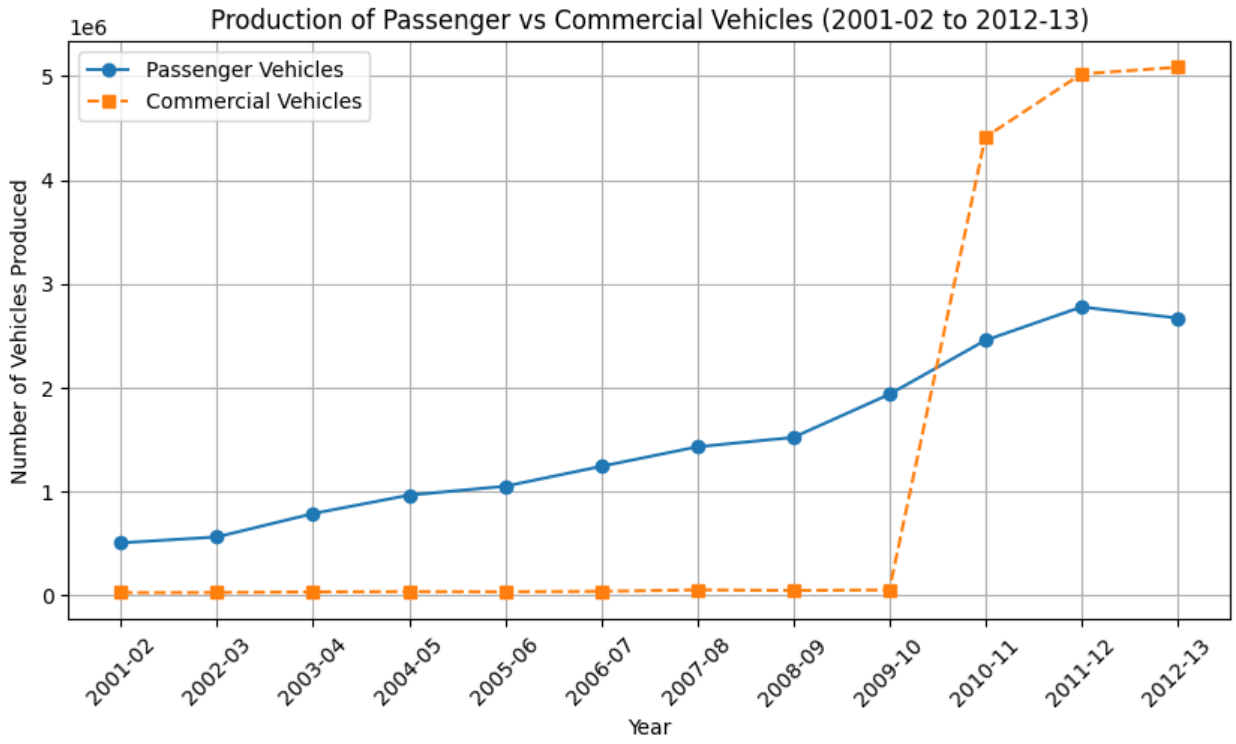
```
# Check for Missing Values
missing_values = df.isnull().sum()
print("Missing Values:\n", missing_values)

# 1. Handling Missing Values
imputer_mean = SimpleImputer(strategy='mean')
df[['2001-02','2002-03','2003-04','2004-05','2005-06','2010-11','2011-
12','2012-13']] = imputer_mean.fit_transform(df[['2001-02','2002-
03','2003-04','2004-05','2005-06','2010-11','2011-12','2012-13']])

# Drop missing values (if a few rows are affected)
df_cleaned = df

# Check again after handling missing data
df_cleaned.isnull().sum()
```

```
Missing Values:
 Category    0
Segment     0
2001-02     1
2002-03     1
2003-04     1
2004-05     1
```

```
2005-06     1
2006-07     0
2007-08     0
2008-09     0
2009-10     0
2010-11     7
2011-12     7
2012-13     7
dtype: int64

Category    0
Segment     0
2001-02     0
2002-03     0
2003-04     0
2004-05     0
2005-06     0
2006-07     0
2007-08     0
2008-09     0
2009-10     0
2010-11     0
2011-12     0
2012-13     0
dtype: int64
```

```
# Extract relevant rows for total production of Passenger and
Commercial Vehicles
#passenger_vehicles = df[df["Segment"] == "Total Passenger Vehicles
(PVs)"]
passenger_vehicles = df[df["Category"] == "Passenger Vehicles (PVs)"]
commercial_vehicles = df[df["Category"].str.contains("Commercial
Vehicles") ]

# Convert to numeric values and reset index
passenger_vehicles = passenger_vehicles.iloc[:, 2:].values.flatten()
commercial_vehicles = commercial_vehicles.iloc[:, 2:].values.flatten()

# Extract years
years = df.columns[2:].tolist()

# Ensure both arrays have the same length
min_length = min(len(passenger_vehicles), len(commercial_vehicles),
len(years))
passenger_vehicles = passenger_vehicles[:min_length]
commercial_vehicles = commercial_vehicles[:min_length]
years = years[:min_length]

# Plot the data
plt.figure(figsize=(10, 5))
```

```
plt.plot(years, passenger_vehicles, marker='o', label="Passenger
Vehicles", linestyle='-')
plt.plot(years, commercial_vehicles, marker='s', label="Commercial
Vehicles", linestyle='--')

# Labels and title
plt.xlabel("Year")
plt.ylabel("Number of Vehicles Produced")
plt.title("Production of Passenger vs Commercial Vehicles (2001-02 to
2012-13)")
plt.xticks(rotation=45)
plt.legend()
plt.grid(True)
plt.show()

print (passenger_vehicles[-1])
print (passenger_vehicles[0])
print (commercial_vehicles[-1])
print (commercial_vehicles[0])

# Calculate percentage growth
pv_growth = ((passenger_vehicles[-1] - passenger_vehicles[0]) /
passenger_vehicles[0]) * 100
cv_growth = ((commercial_vehicles[-1] - commercial_vehicles[0]) /
commercial_vehicles[0]) * 100



# Print the results
print(f"Total growth recorded for passenger vehicles: {pv_growth:.2f}
%")
print(f"Total growth recorded for commercial vehicles: {cv_growth:.2f}
%")
```




```
2668633.0
500301.0
5086578.25
20283.0
Total growth recorded for passenger vehicles: 433.41%
Total growth recorded for commercial vehicles: 24978.04%
```

# 1.Summarise the findings from the visual.

- The production of passenger vehicles has shown steady growth from 2001-02 to 2012-13, increasing by 433.41% over the period.
- The production of commercial vehicles remained low and stable until 2008-09, after which it saw a sharp rise from 2009-10 onwards, resulting in a massive growth of 24,978.04%
- The steep increase in commercial vehicles around 2009-10 indicates a sudden surge in production, possibly due to government policies, market demand, or industry expansion.
- In 2012-13, the production of both vehicle types appears to have stabilized, with passenger vehicles showing a slight decline.

# 2.The reason for selecting the chart type.

- Trend Representation: A line chart is ideal for visualizing trends over time. It effectively showcases how vehicle production has changed across multiple years.

- Comparison of Two Categories: The use of two separate lines (solid for passenger vehicles, dashed for commercial vehicles) allows for easy comparison of production trends.
- Highlighting Growth Points: The marker points clearly indicate production levels at each time step, making it easy to identify inflection points (like the 2009-10 surge in commercial vehicles).

# 3. The pre-attentive attributes used.

- Color - Passenger Vehicles are represented with a blue solid line, while Commercial Vehicles are in an orange dashed line, making them easily distinguishable.
- Line Style & Shape - The solid line (passenger vehicles) vs. dashed line (commercial vehicles) provides an additional visual distinction to separate the two categories.

# 4. The gestalt principles used.

- Continuity - Data points that are closer together along the timeline are perceived as belonging to the same trend.
- Proximity - The lines connecting data points create a continuous flow, helping the viewer follow the trend smoothly over time
- In percentage terms, the total growth recorded for passenger vehicles is **433.41%** during the period from 2001-02 to 2012-13.
- In percentage terms, the total growth recorded for commercial vehicles is **24,978.04%** during the period from 2001-02 to 2012-13.

```
print(df)
```

```
                                Category
Segment  \
0              Passenger Vehicles (PVs)                    Passenger
Cars
1              Passenger Vehicles (PVs)           Multi-Utility
Vehicles
2              Passenger Vehicles (PVs)   Total Passenger Vehicles
(PVs)
3   Commercial Vehicles (CVs) M & HCVs               Passenger
Carriers
4   Commercial Vehicles (CVs) M & HCVs                   Goods
Carriers
5   Commercial Vehicles (CVs) M & HCVs                   Total M &
HCVs
6                                LCVs               Passenger
Carriers
7                                LCVs                   Goods
```

```
Carriers
8                                    LCVs                          Total
LCVs
9      Total Commercial Vehicles (CVs)  Total Commercial Vehicles
(CVs)
10                        Three Wheelers                Passenger
Carriers
11                        Three Wheelers                    Goods
Carriers
12                        Three Wheelers              Total Three
Wheelers
13                          Two wheelers
Scooter/Scooterettee
14                          Two wheelers        Motorcycles/Step-
Throughs
15                          Two wheelers
Mopeds
16                          Two wheelers             Electric Two
Wheelers
17                          Two wheelers                Total Two
wheelers
18                           Grand Total                       Grand
Total

         2001-02       2002-03       2003-04    2004-05    2005-06
2006-07  \
0   5.003010e+05  5.574100e+05  7.825620e+05   960487.0  1046133.0
1238032
1   1.694180e+05  1.659200e+05  2.069980e+05   249389.0   263167.0
307202
2   6.697190e+05  7.233300e+05  9.895600e+05  1209876.0  1309300.0
1545234
3   2.028300e+04  2.115600e+04  2.762800e+04    30419.0    28982.0
32828
4   7.646900e+04  9.934600e+04  1.384950e+05   184388.0   190313.0
261438
5   9.675200e+04  1.205020e+05  1.661230e+05   214807.0   219295.0
294258
6   1.497700e+04  1.982100e+04  2.096200e+04    22619.0    25395.0
29443
7   5.077900e+04  6.337400e+04  8.795500e+04   116277.0   146393.0
196291
8   6.575600e+04  8.319500e+04  1.089170e+05   138896.0   171788.0
225734
9   1.625080e+05  2.036970e+05  2.750400e+05   353703.0   391083.0
519982
10  1.700130e+05  2.104540e+05  2.450840e+05   237413.0   286987.0
385443
11  4.273500e+04  6.626500e+04  1.111390e+05   137032.0   147436.0
```

```
170681
12  2.127480e+05  2.767190e+05  3.562230e+05   374445.0   434423.0
556126
13  9.375060e+05  8.484340e+05  9.352790e+05   987498.0  1021013.0
943974
14  2.906323e+06  3.876175e+06  4.355168e+06  5193894.0  6207690.0
7112225
15  4.274980e+05  3.516120e+05  3.322940e+05   348437.0   379994.0
379987
16  8.950786e+05  1.057978e+06  1.222541e+06  1430959.0  1645644.0
30454
17  4.271327e+06  5.076221e+06  5.622741e+06  6529829.0  7608697.0
8466640
18  5.316302e+06  6.279967e+06  7.243564e+06  8467853.0  9743503.0
11087992

     2007-08   2008-09   2009-10       2010-11       2011-12
2012-13
0    1426212   1516967   1932620  2.453113e+06  2.775124e+06
2668633.00
1     351371    321626    424791  5.341830e+05  3.709450e+05
564928.00
2    1777583   1838593   2357411  2.987296e+06  3.146069e+06
3233561.00
3      46542     40995     46026  4.412379e+06  5.022232e+06
5086578.25
4     248415    151288    204145  4.412379e+06  5.022232e+06
5086578.25
5     294957    192283    250133  3.445420e+05  3.848010e+05
278560.00
6      33882     28635     34751  4.412379e+06  5.022232e+06
5086578.25
7     220167    195952    281686  4.412379e+06  5.022232e+06
5086578.25
8     254049    224587    317423  4.081930e+05  5.443350e+05
553184.00
9     549006    416870    567556  7.527350e+05  9.291360e+05
831744.00
10    371060    417434    530203  4.412379e+06  5.022232e+06
5086578.25
11    129600     79586     88890  4.412379e+06  5.022232e+06
5086578.25
12    500660    497020    619194  7.995530e+05  8.792890e+05
839742.00
13   1074933   1161276   1494409  2.144765e+06  2.659340e+06
3025014.00
14   6503532   6798118   8444857  1.052711e+07  1.198267e+07
11904212.00
15    430827    436219    571070  7.045750e+05  7.855230e+05
```

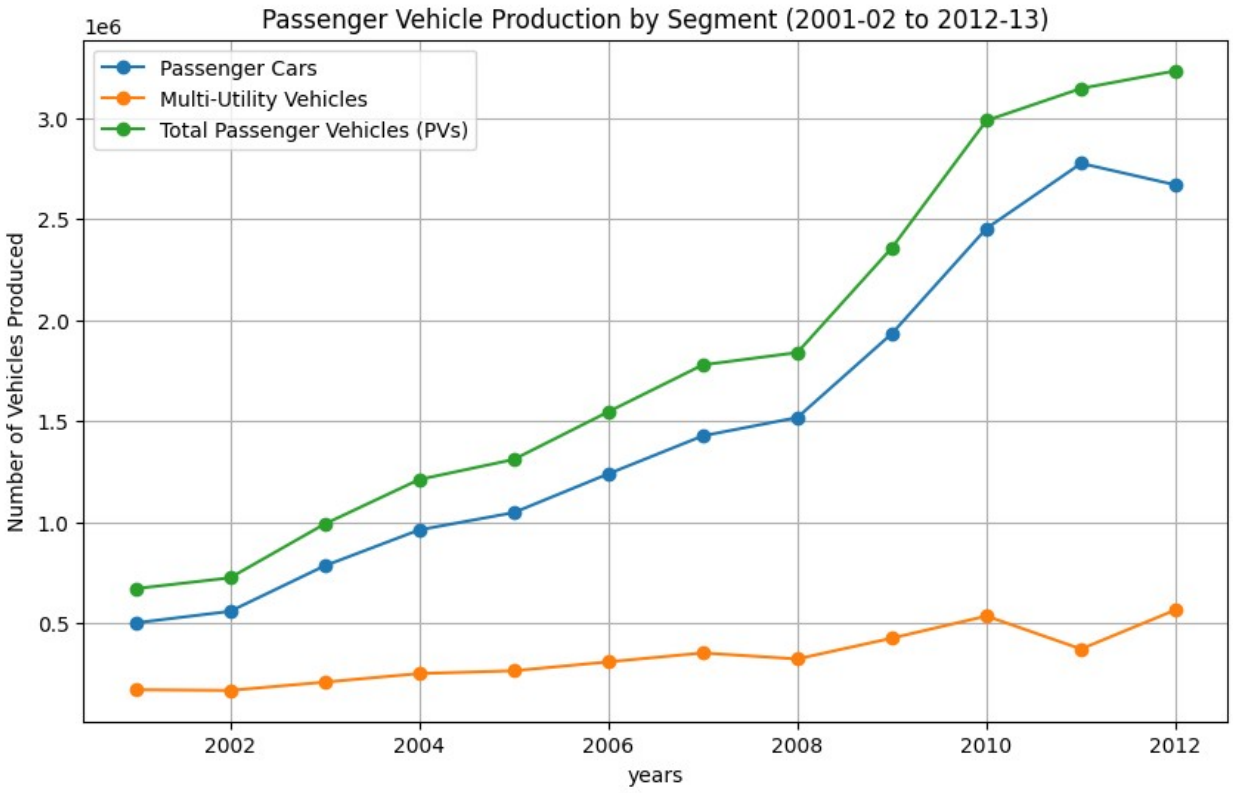
```
791954.00
16     17389     24179      2567  4.412379e+06  5.022232e+06
5086578.25
17   8026681   8419792  10512903  1.337645e+07  1.542753e+07
15721180.00
18  10853930  11172275  14057064  1.791604e+07  2.038203e+07
20626227.00
```

# Passenger Vehicle Data

# Analyse the passenger vehicle production(segment wise) during 2001-02 to 2012-13

```
# Extract the relevant data for Passenger Vehicles segment-wise
years = df.columns[2:]  # Extracting year columns
pv_data = df[df['Category'] == 'Passenger Vehicles
(PVs)'].set_index('Segment').iloc[:, 1:]
pv_data_transposed = pv_data.T

# Convert year columns to numeric type
years_numeric = [int(year.split('-')[0]) for year in years]

# Plot segment-wise passenger vehicle production
plt.figure(figsize=(10, 6))
for segment in pv_data_transposed.columns:
    plt.plot(years_numeric, pv_data_transposed[segment], marker='o',
linestyle='-', label=segment)

plt.xlabel("years")
plt.ylabel("Number of Vehicles Produced")
plt.title("Passenger Vehicle Production by Segment (2001-02 to 2012-
13)")
plt.legend()
plt.grid(True)
plt.show()

# Calculate percentage growth for each segment from 2001-02 to 2012-13
pv_growth = ((pv_data_transposed.iloc[-1] -
pv_data_transposed.iloc[0]) / pv_data_transposed.iloc[0]) * 100

# Convert to percentage format with two decimal places
pv_growth = pv_growth.map(lambda x: f"{x:.2f}%")
```

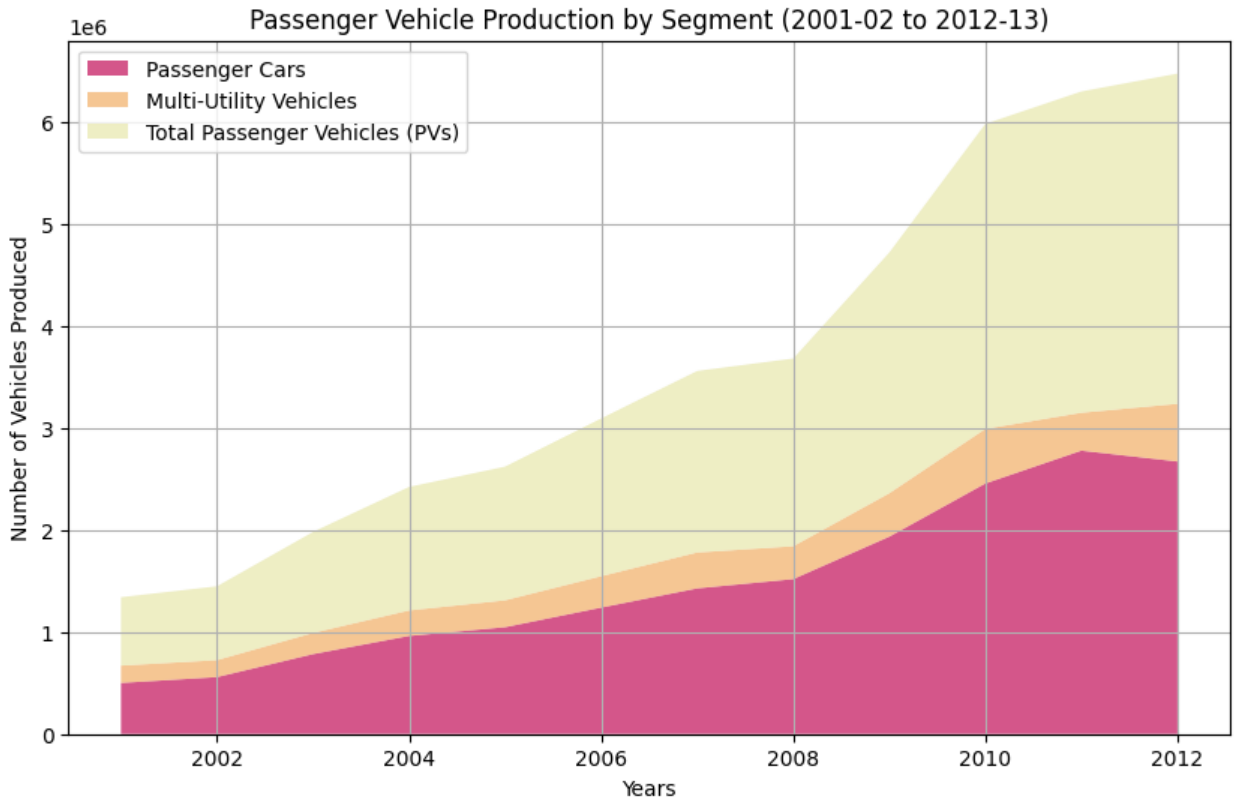
```
# Display percentage growth for each segment
print("Percentage Growth of Passenger Vehicle Segments (2001-02 to
2012-13):")
print(pv_growth)
```




```
Percentage Growth of Passenger Vehicle Segments (2001-02 to 2012-13):
Segment
Passenger Cars                      433.41%
Multi-Utility Vehicles              233.45%
Total Passenger Vehicles (PVs)      382.82%
dtype: object
```

```
# Extract the relevant data for Passenger Vehicles segment-wise
years = [col for col in df.columns if col not in ['Category',
'Segment']]
pv_data = df[df['Category'] == 'Passenger Vehicles
(PVs)'].set_index('Segment').loc[:, years]
pv_data_transposed = pv_data.T

# Convert year columns to numeric type
years_numeric = [int(year.split('-')[0]) if '-' in year else int(year)
for year in years]

# Plot segment-wise passenger vehicle production
plt.figure(figsize=(10, 6))
```

```
plt.stackplot(years_numeric, pv_data_transposed["Passenger Cars"],
              pv_data_transposed["Multi-Utility Vehicles"],
              pv_data_transposed["Total Passenger Vehicles (PVs)"],
              labels=["Passenger Cars", "Multi-Utility Vehicles",
"Total Passenger Vehicles (PVs)"],
              colors= ["#C30E59", "#F2AE66", "#E8E7AB"], alpha=0.7)

plt.xlabel("Years")
plt.ylabel("Number of Vehicles Produced")
plt.title("Passenger Vehicle Production by Segment (2001-02 to 2012-
13)")
plt.legend()
plt.grid(True)
plt.show()

# Calculate percentage growth
pv_growth = ((pv_data_transposed.iloc[-1] -
pv_data_transposed.iloc[0]) / pv_data_transposed.iloc[0]) * 100

# Format percentage growth with two decimal places
pv_growth = pv_growth.map(lambda x: f"{x:.2f}%")

# Display percentage growth for each segment
print("Percentage Growth of Passenger Vehicle Segments (2001-02 to
2012-13):")
print(pv_growth)
```




```
Percentage Growth of Passenger Vehicle Segments (2001-02 to 2012-13):
Segment
Passenger Cars                    433.41%
Multi-Utility Vehicles            233.45%
Total Passenger Vehicles (PVs)    382.82%
dtype: object
```

## 1. Summary of the findings

- The total passenger vehicle production in India has shown a steady increase from 2001-02 to 2012-13.Passenger cars passenger cars (blue section) form the largest share of total production.
- Vans (green section) make up the smallest share of the total production but have also shown a gradual increase.
- Multi-Utility Vehicles (MUVs) (red section) have also grown significantly, but their contribution remains smaller than passenger cars
- There is a notable spike in production after 2009-10, suggesting industry growth, increased demand, or government policies promoting vehicle production.

## 2. Why was this chart type selected?

- Represents Total Contribution: This stacked area chart is ideal for showing the overall production trend while also highlighting the contribution of each vehicle type.
- Easier Comparison: Each section (passenger cars, MUVs, vans) is visually distinct, making it easier to compare their growth over time.

- Highlights Trends Over Time: The cumulative area provides a clear picture of how each category contributes to the total production growth.

### 3. Pre-attentive Attributes

- Color - Different colors (blue, red, green) effectively separate the three vehicle categories for easy identification.
- Size (Area Coverage) - The relative area size of each category allows quick visual comparison (passenger cars dominate, MUVs come next, vans are the smallest).

### 3. Gestalt Principle used

- Proximity - The stacked nature of the chart visually groups related data together (e.g., all vehicle types are combined to show total production).
- Similarity - Consistent color coding (blue for passenger cars, red for MUVs, green for vans) helps the viewer recognize each category quickly.
- In percentage terms, the growth of production of passenger cars in India was **433.41%** during the period from 2001-02 to 2012-13.
- In percentage terms, the growth of production of Multi-Utility Vehicles (MUVs) in India was **233.45%** during the period from 2001-02 to 2012-13.

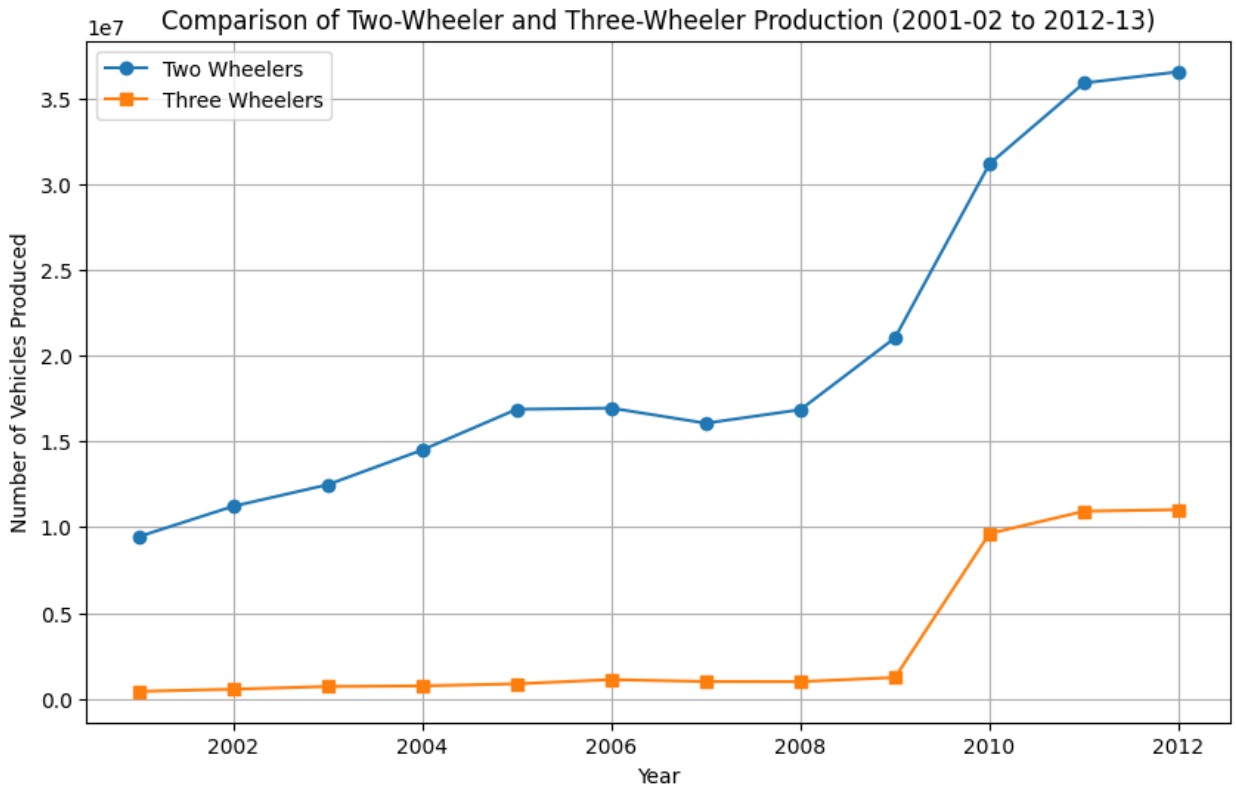
# 2-Wheeler Data vs 3-Wheeler

## Question 3 - Compare the production of 2-wheeler and 3-wheelers in India from 2001-02 to 2012-13, in a single visual.

## Write the python code in the below cell to create appropriate visual to perform the above task

```
# Extract the relevant data for Two-Wheelers and Three-Wheelers
years = df.columns[2:]  # Extracting year columns

tw_data = df[df['Category'] == 'Two wheelers'].iloc[:,
2:].sum().values.flatten()
thw_data = df[df['Category'] == 'Three Wheelers'].iloc[:,
2:].sum().values.flatten()

# Convert year columns to numeric type
years_numeric = [int(year.split('-')[0]) for year in years]

# Plot the production trends of Two-Wheelers and Three-Wheelers
plt.figure(figsize=(10, 6))
plt.plot(years_numeric, tw_data, marker='o', linestyle='-', label='Two
Wheelers')
plt.plot(years_numeric, thw_data, marker='s', linestyle='-',
```

```
label='Three Wheelers')

# Labels and Title
plt.xlabel("Year")
plt.ylabel("Number of Vehicles Produced")
plt.title("Comparison of Two-Wheeler and Three-Wheeler Production
(2001-02 to 2012-13)")
plt.legend()
plt.grid(True)

# Show the plot
plt.show()
```




1.Summary of Findings from the Visual

- The production of 2-wheelers in India has shown consistent growth from 2001-02 to 2012-13, increasing from around 4 million to nearly 16 million units
- The production of 3-wheelers remained relatively stable, with minor fluctuations but no significant growth compared to 2-wheelers.
- Around 2008-09, 2-wheeler production saw rapid growth, possibly due to increased demand, affordability, or government policies supporting the sector.
- By 2011-12 and 2012-13, 2-wheeler production reached its peak, indicating strong market expansion.
- 3-wheelers saw only a slight increase over the period, suggesting they did not experience the same level of demand or market penetration.

2. Reason for Selecting the Chart Type (Line Chart with Markers)

- Best for Time Series Analysis: A line chart is effective in showing trends over time, making it easy to observe growth patterns.
- Comparison Between Categories: The use of two separate lines (blue for 2-wheelers, red for 3-wheelers) allows for clear differentiation and comparison.
- Marker Points Highlight Data Trends: The circular markers for 2-wheelers and square markers for 3-wheelers ensure that individual data points are clearly visible.

3. Pre-Attentive Attributes Used

- Color - The blue line represents 2-wheelers, while the red line represents 3-wheelers, making it easy to differentiate between the two categories.
- Line Style & Markers - The solid blue line with circular markers for 2-wheelers and the dashed red line with square markers for 3-wheelers provide a quick visual distinction.

4. Gestalt Principles Used

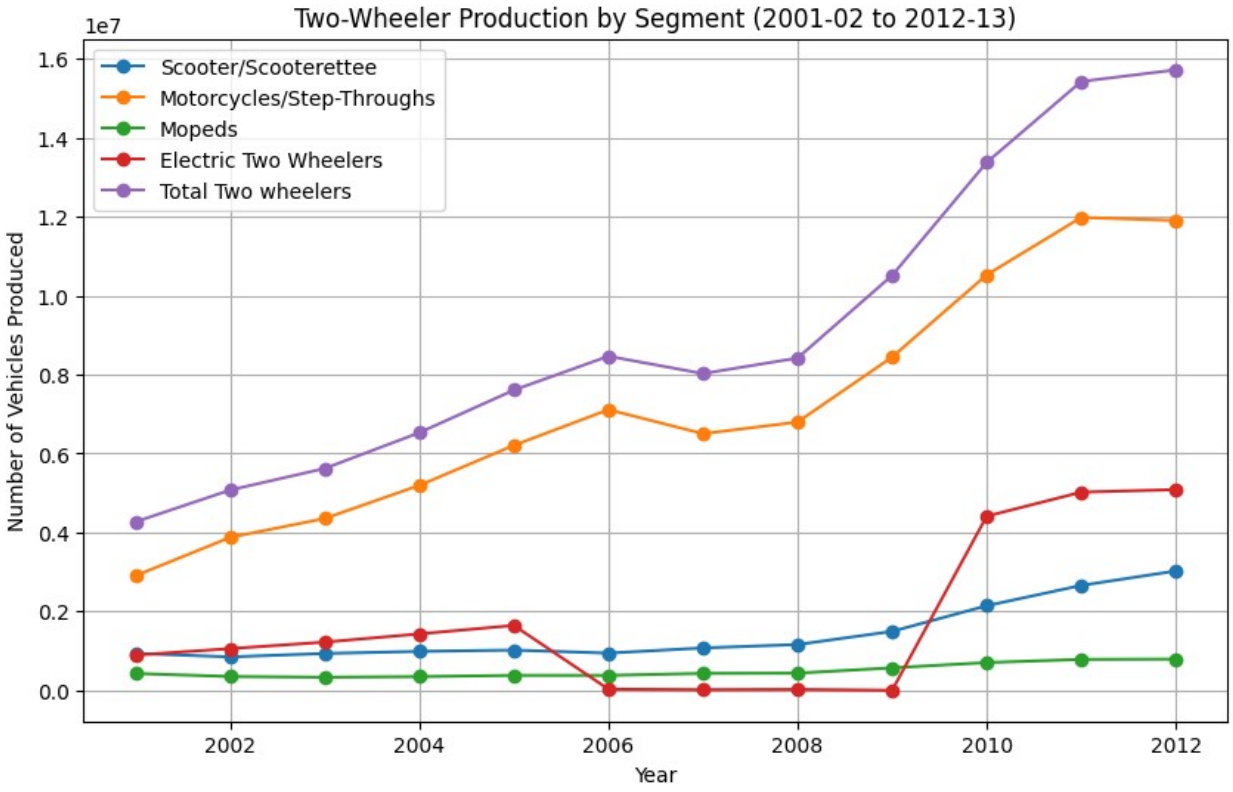
- Proximity - The closeness of data points within each category makes it easier to recognize them as part of the same trend.
- Continuity - The connected lines between data points create a continuous flow, allowing the viewer to follow the trend over time effortlessly.

# 2-Wheeler Production in India

## Analyse the two wheeler production in India(segment wise) during 2001-02 to 2012-13.

```
# Extract the relevant data for Two-Wheelers segment-wise
years = df.columns[2:]  # Extracting year columns
tw_data = df[df['Category'] == 'Two
wheelers'].set_index('Segment').iloc[:, 1:]
tw_data_transposed = tw_data.T

# Convert year columns to numeric type
years_numeric = [int(year.split('-')[0]) for year in years]

# Plot segment-wise two-wheeler production
plt.figure(figsize=(10, 6))
for segment in tw_data_transposed.columns:
    plt.plot(years_numeric, tw_data_transposed[segment], marker='o',
linestyle='-', label=segment)

plt.xlabel("Year")
plt.ylabel("Number of Vehicles Produced")
plt.title("Two-Wheeler Production by Segment (2001-02 to 2012-13)")
plt.legend()
plt.grid(True)
plt.show()

# Calculate percentage growth for each segment from 2001-02 to 2012-13
```

```
tw_growth = ((tw_data_transposed.iloc[-1] -
tw_data_transposed.iloc[0]) / tw_data_transposed.iloc[0]) * 100

## Display percentage growth for each segment
tw_growth = tw_growth.map(lambda x: f"{x:.2f}%")

# Display percentage growth for each segment
print("Percentage Growth of Two-Wheeler Segments (2001-02 to 2012-
13):")
print(tw_growth)
```




```
Percentage Growth of Two-Wheeler Segments (2001-02 to 2012-13):
Segment
Scooter/Scooterettee          222.67%
Motorcycles/Step-Throughs     309.60%
Mopeds                         85.25%
Electric Two Wheelers         468.28%
Total Two wheelers            268.06%
dtype: object
```

1. Summary of Findings

- Motorcycles dominate the two-wheeler segment, growing from 3.00M (2001-02) to 13.50M (2012-13).
- Scooter production increased steadily, reaching 1.90M in 2012-13.

- Moped production remained stagnant, with slight variations but showing a downward trend in the later years.
- The shift suggests a growing preference for motorcycles and scooters over mopeds.

2. Why This Chart Type Was Selected?
- A stacked area chart was chosen because it shows the relative contribution of each segment over time.
- It helps visualize both absolute numbers and trends in segment-wise production.

3. Pre-attentive Attributes Used
- Color: Different colors represent motorcycles (blue), scooters (red), and mopeds (green).
- Size/Height: The area size helps compare the relative production of each segment.

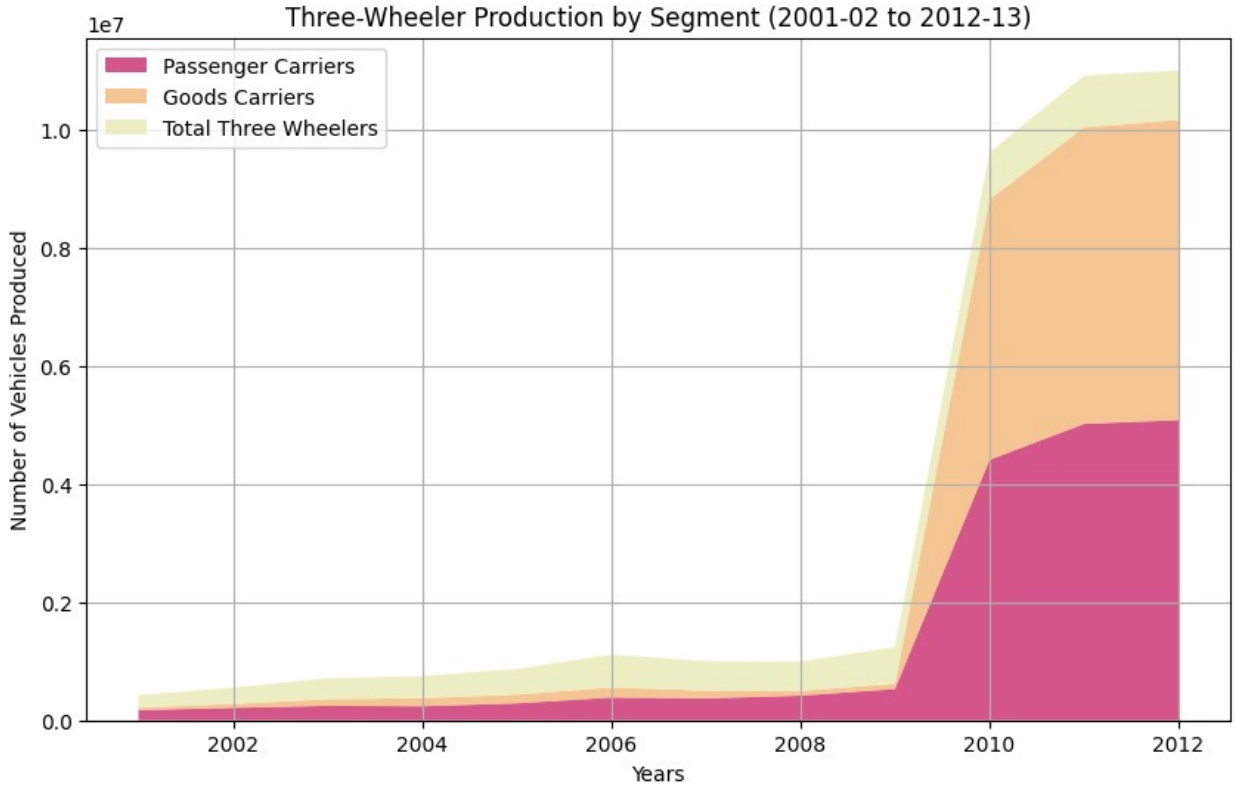
4. Gestalt Principles Used
- Area as a visual cue: The larger the area, the greater the production of that segment.
- Continuity: The smooth stacked layers help track changes over time naturally.

# 3-wheeler Production In India

## Analyse the three wheeler production in India(segment wise) during 2001-02 to 2012-13.

```
# Extract relevant data for Three-Wheelers
years = [col for col in df.columns if col not in ['Category',
'Segment']]
thw_data = df[df['Category'] == 'Three
Wheelers'].set_index('Segment').loc[:, years]

# Transpose data for plotting
thw_data_transposed = thw_data.T

# Convert year columns to numeric type
years_numeric = [int(year.split('-')[0]) if '-' in year else int(year)
for year in years]

# Handle missing values using forward fill
thw_data_transposed = thw_data_transposed.ffill()

# Define colors (pink and orange gradient-like shades)
colors = ["#C30E59", "#F2AE66", "#E8E7AB"]
[:len(thw_data_transposed.columns)]

# Plot segment-wise three-wheeler production as an area chart
plt.figure(figsize=(10, 6))
plt.stackplot(years_numeric, *[thw_data_transposed[segment] for
segment in thw_data_transposed.columns],
              labels=thw_data_transposed.columns, colors=colors,
```

```
alpha=0.7)

plt.xlabel("Years")
plt.ylabel("Number of Vehicles Produced")
plt.title("Three-Wheeler Production by Segment (2001-02 to 2012-13)")
plt.legend()
plt.grid(True)
plt.show()

# Calculate percentage growth for each segment from 2001-02 to 2012-13
thw_growth = ((thw_data_transposed.iloc[-1] -
thw_data_transposed.iloc[0]) / thw_data_transposed.iloc[0]) * 100

# Format percentage growth with two decimal places
thw_growth = thw_growth.map(lambda x: f"{x:.2f}%")

# Display percentage growth for each segment
print("Percentage Growth of Three-Wheeler Segments (2001-02 to 2012-
13):")
print(thw_growth)
```




```
Percentage Growth of Three-Wheeler Segments (2001-02 to 2012-13):
Segment
Passenger Carriers       2891.88%
Goods Carriers          11802.61%
```

```
Total Three Wheelers      294.71%
dtype: object
```

1. Summary of Findings
   - Passenger three-wheeler production shows a significant increase, growing from 0.18M (2001-02) to 0.65M (2012-13).
   - Goods three-wheeler production also increased but at a slower rate, reaching 0.19M in 2012-13.
   - Passenger three-wheelers dominate production, accounting for a larger share of total three-wheeler production.

2. Why This Chart Type Was Selected?
   - A stacked area chart was used to show the relative contribution of passenger and goods three-wheelers over time.
   - It helps in visualizing growth trends while comparing absolute production numbers.

3. Pre-attentive Attributes Used
   - Color: Different colors represent passenger (blue) and goods (red) three-wheelers.
   - size/Height: The height of each area makes it easy to compare production levels.

4. Gestalt Principles Used
   - Area as a visual cue: The larger area of passenger three-wheelers shows their higher production share.
   - Continuity: The smooth, stacked layers help track production changes over time.

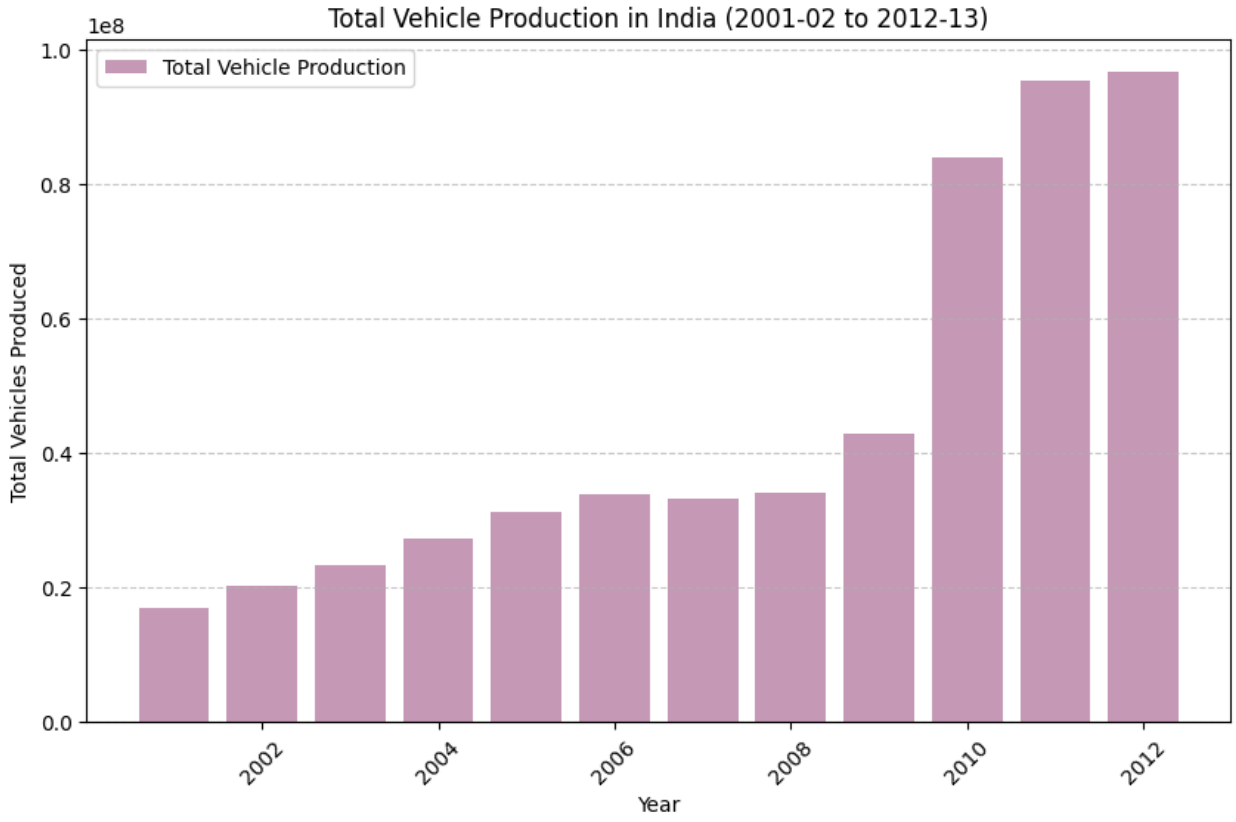
# Group's choice-2 Marks

## "How has the total vehicle production in India evolved across all categories from 2001-02 to 2012-13?"

To analyze this, we will sum up the production of all vehicle categories for each year and visualize the trend using a line chart. This will help us identify overall growth patterns, peaks, or slowdowns in the Indian automobile industry.

```
import matplotlib.pyplot as plt

# Extract years and sum production across all categories for each year
years = df.columns[2:]  # Extract year columns
total_production = df.iloc[:, 2:].sum().values  # Summing production values across all categories

# Convert year columns to numeric type
years_numeric = [int(year.split('-')[0]) for year in years]

# Plot the total vehicle production trend as a bar chart
```

```
plt.figure(figsize=(10, 6))
plt.bar(years_numeric, total_production, color='#C599B6', label='Total
Vehicle Production')

# Labels and Title
plt.xlabel("Year")
plt.ylabel("Total Vehicles Produced")
plt.title("Total Vehicle Production in India (2001-02 to 2012-13)")
plt.xticks(rotation=45)  # Rotate x-axis labels for better readability
plt.legend()
plt.grid(axis='y', linestyle='--', alpha=0.7)  # Grid only on y-axis
for clarity

# Show the plot
plt.show()
```




1. Summary of Findings

- Two-wheelers account for the largest share of production every year, showing steady growth.
- Passenger vehicles have shown significant growth, especially after 2005-06.
- Commercial vehicles have a smaller share, but there is a noticeable increase in production.

- Three-wheelers remain the least produced category, with relatively stable production trends.

## 2. Why This Chart Type Was Selected?

- A bar chart was chosen instead of a line chart for the following reasons:

Clear Yearly Comparison – A bar chart makes it easier to compare total vehicle production year by year, as each bar represents a specific year. Better Visibility for Discrete Data – Since production data is recorded annually, bars emphasize distinct values better than a continuous line. Highlighting Growth Trends – The height of the bars makes it easier to see trends, such as increases or decreases over time. Avoiding Misinterpretation – A line chart is better for continuous data, whereas a bar chart is ideal for categorical or grouped data like yearly production totals.

## 3. Pre-attentive Attributes Used

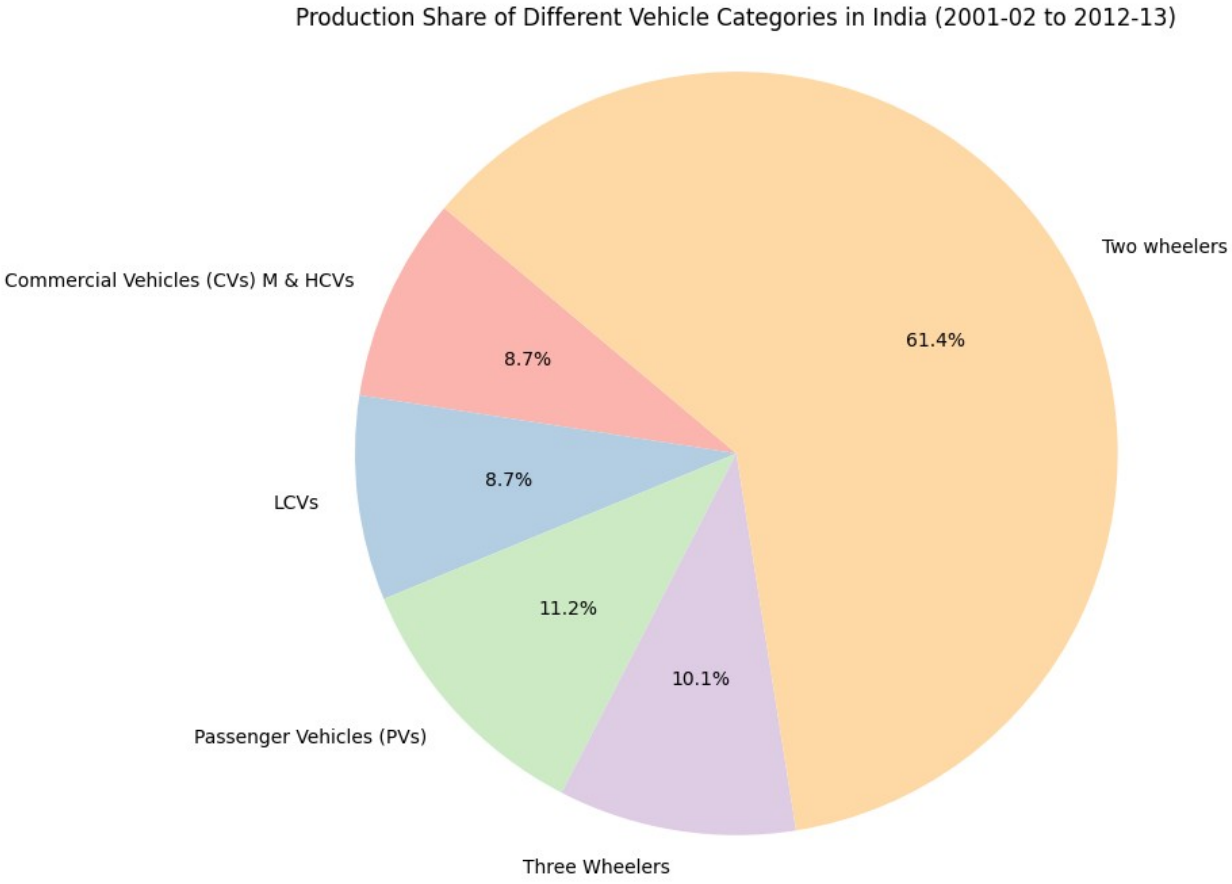
- Color: Different colors represent each vehicle category, making them easy to distinguish.
- Height/Size: The height of each bar segment makes it easy to compare production levels across years.

## 4. Gestalt Principles Used

- Proximity: The bars are grouped by year, making comparisons within each year easier.
- Common Fate: The stacked bars move together, showing the overall trend of vehicle production.

```
import matplotlib.pyplot as plt

# Filter out any "Total" or "Grand Total" rows
df_filtered = df[~df["Category"].str.contains("Total", case=False,
na=False)]

# Group data by Category and sum production over all years
category_totals =
df_filtered.groupby("Category").sum(numeric_only=True).sum(axis=1)

# Compute total vehicle production (excluding Grand Total)
total_production = category_totals.sum()

# Calculate production share (%)
category_share = (category_totals / total_production) * 100

# Plot pie chart
plt.figure(figsize=(8, 8))
plt.pie(category_share, labels=category_share.index, autopct="%1.1f%
%",
        startangle=140, colors=plt.cm.Pastel1.colors)

plt.title("Production Share of Different Vehicle Categories in India
(2001-02 to 2012-13)")
plt.axis("equal")  # Equal aspect ratio ensures that pie is drawn as a
circle
```

```
# Show plot
plt.show()
```




Proportional Representation – A pie chart is ideal for showing how different categories contribute to the total production. Easy to Compare – The percentage labels make it easy to see which category dominates production. Good for Limited Categories – Since we have a few distinct vehicle categories, a pie chart is a clear and simple way to represent the data.

## 1. Summary of Findings

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