Import Data

In [26]:
```
import pandas
import seaborn
import matplotlib.pyplot as plt
```

In [16]:
```
dataframe = pandas.read_csv('Electric_Vehicle_Population_Data.csv')
```

In [17]:
```
dataframe.head
```

Out[17]:

```
<bound method NDFrame.head of         VIN (1-10)    County        City State  Postal
Code  Model Year  \
0       5UXTA6C05P    Yakima      Yakima    WA      98903.0        2023
1       5YJRE11B48       NaN         NaN    BC          NaN        2008
2       5YJSA1E24G      King     Seattle    WA      98103.0        2016
3       1N4AZ1CP5J      King   Shoreline    WA      98177.0        2018
4       5YJ3E1EA6J    Island  Coupeville    WA      98239.0        2018
...            ...       ...         ...   ...         ...         ...
153825  1N4AZ0CP0D  San Juan   Eastsound    WA      98245.0        2013
153826  5YJSA1E27H   Spokane     Spokane    WA      99223.0        2017
153827  1G1FW6S03P      King      Seatac    WA      98188.0        2023
153828  3FMTK3SU1M      King        Kent    WA      98031.0        2021
153829  1N4AZ0CP0D    Pierce      Tacoma    WA      98407.0        2013

             Make           Model                     Electric Vehicle Type  \
0             BMW              X5  Plug-in Hybrid Electric Vehicle (PHEV)
1           TESLA        ROADSTER          Battery Electric Vehicle (BEV)
2           TESLA         MODEL S          Battery Electric Vehicle (BEV)
3          NISSAN            LEAF          Battery Electric Vehicle (BEV)
4           TESLA         MODEL 3          Battery Electric Vehicle (BEV)
...           ...             ...                                     ...
153825     NISSAN            LEAF          Battery Electric Vehicle (BEV)
153826      TESLA         MODEL S          Battery Electric Vehicle (BEV)
153827  CHEVROLET         BOLT EV          Battery Electric Vehicle (BEV)
153828       FORD  MUSTANG MACH-E          Battery Electric Vehicle (BEV)
153829     NISSAN            LEAF          Battery Electric Vehicle (BEV)

        Clean Alternative Fuel Vehicle (CAFV) Eligibility  Electric Range  \
0                 Clean Alternative Fuel Vehicle Eligible              30
1                 Clean Alternative Fuel Vehicle Eligible             220
2                 Clean Alternative Fuel Vehicle Eligible             210
3                 Clean Alternative Fuel Vehicle Eligible             151
4                 Clean Alternative Fuel Vehicle Eligible             215
...                                                  ...             ...
153825            Clean Alternative Fuel Vehicle Eligible              75
153826            Clean Alternative Fuel Vehicle Eligible             210
153827  Eligibility unknown as battery range has not b...               0
153828  Eligibility unknown as battery range has not b...               0
153829            Clean Alternative Fuel Vehicle Eligible              75

        Base MSRP  Legislative District  DOL Vehicle ID  \
0               0                 14.0       227153587
1           98950                  NaN       143609049
2               0                 43.0       187728201
3               0                 32.0       249867971
4               0                 10.0       223792649
...           ...                  ...             ...
153825          0                 40.0       154379130
153826          0                  6.0       204991475
153827          0                 33.0       244720059
153828          0                 33.0       186104215
153829          0                 27.0       153724504

                     Vehicle Location  \
0         POINT (-120.477805 46.553505)
1                                   NaN
2          POINT (-122.34301 47.659185)
3          POINT (-122.382425 47.77279)
4       POINT (-122.6880708 48.2179983)
...                                ...
```

```
153825   POINT (-122.907229 48.7016716)
153826     POINT (-117.369705 47.62637)
153827      POINT (-122.29179 47.43473)
153828  POINT (-122.2012521 47.3931814)
153829  POINT (-122.5113356 47.2923828)

                                       Electric Utility  2020 Census Tract
0                                            PACIFICORP       5.307700e+10
1                                                   NaN               NaN
2           CITY OF SEATTLE - (WA)|CITY OF TACOMA - (WA)       5.303300e+10
3           CITY OF SEATTLE - (WA)|CITY OF TACOMA - (WA)       5.303302e+10
4                               PUGET SOUND ENERGY INC       5.302997e+10
...                                                 ...               ...
153825  BONNEVILLE POWER ADMINISTRATION||ORCAS POWER &...       5.305596e+10
153826  BONNEVILLE POWER ADMINISTRATION||INLAND POWER ...       5.306301e+10
153827     PUGET SOUND ENERGY INC||CITY OF TACOMA - (WA)       5.303303e+10
153828     PUGET SOUND ENERGY INC||CITY OF TACOMA - (WA)       5.303303e+10
153829  BONNEVILLE POWER ADMINISTRATION||CITY OF TACOM...       5.305306e+10

[153830 rows x 17 columns]>
```

In [18]:
```
dataframe
```

Out[18]:

	VIN (1-10)	County	City	State	Postal Code	Model Year	Make	Model	Electric Vehicle Type	A
0	5UXTA6C05P	Yakima	Yakima	WA	98903.0	2023	BMW	X5	Plug-in Hybrid Electric Vehicle (PHEV)	
1	5YJRE11B48	NaN	NaN	BC	NaN	2008	TESLA	ROADSTER	Battery Electric Vehicle (BEV)	
2	5YJSA1E24G	King	Seattle	WA	98103.0	2016	TESLA	MODEL S	Battery Electric Vehicle (BEV)	
3	1N4AZ1CP5J	King	Shoreline	WA	98177.0	2018	NISSAN	LEAF	Battery Electric Vehicle (BEV)	
4	5YJ3E1EA6J	Island	Coupeville	WA	98239.0	2018	TESLA	MODEL 3	Battery Electric Vehicle (BEV)	
...	...	...	...	...	...	...	...	...	...	
153825	1N4AZ0CP0D	San Juan	Eastsound	WA	98245.0	2013	NISSAN	LEAF	Battery Electric Vehicle (BEV)	
153826	5YJSA1E27H	Spokane	Spokane	WA	99223.0	2017	TESLA	MODEL S	Battery Electric Vehicle (BEV)	
153827	1G1FW6S03P	King	Seatac	WA	98188.0	2023	CHEVROLET	BOLT EV	Battery Electric Vehicle (BEV)	
153828	3FMTK3SU1M	King	Kent	WA	98031.0	2021	FORD	MUSTANG MACH-E	Battery Electric Vehicle (BEV)	

	VIN (1-10)	County	City	State	Postal Code	Model Year	Make	Model	Electric Vehicle Type	A
153829	1N4AZ0CP0D	Pierce	Tacoma	WA	98407.0	2013	NISSAN	LEAF	Battery Electric Vehicle (BEV)	

153830 rows × 17 columns

Part 1: Introduction (15 Points)

A brief summary of the type of data you've chosen to work with and the research question you hope to answer with it.

- Brief Summary: Electric vehicle data from the State of Washington (sourced from Data.gov) Research Questions:

1. Were there more Teslas sold than any other kind of vehicle in Washington State?
2. How many vehicles were sold in each year? What was the trend in sales over time?
3. Is there a correlation between ...

Part 2: Data Summary (10 Points)

Explain where you acquired your data from; how many use cases your data set provides; how many attributes are in each use case; what the data types are for each of the attributes; etc. Be sure to include any Python code used as part of your Data Summary work.

- Data acquired from Data.gov
- Potentially numerous use cases

Part 3: Exploratory Data Analysis (EDA) (25 Points)

Provide summary statistics for each attribute; provide appropriate graphical analysis for each attribute using both Matplotlib and Seaborn. For example, if you believe it is appropriate to generate a histogram for a particular variable as part of your EDA, create it first using Matplotlib and then once again using Seaborn. Include a narrative describing your EDA findings. Be sure include any Python code used as part of your EDA work.

In [50]:
```
dataframe.describe()
```

Out[50]:

	Postal Code	Model Year	Electric Range	Base MSRP	Legislative District	DOL Vehicle ID	20
count	153827.000000	153830.000000	153830.000000	153830.000000	153491.000000	1.538300e+05	1.53
mean	98171.496226	2020.100780	65.727673	1273.032276	29.302558	2.124161e+08	5.29
std	2437.224154	3.019617	95.147219	9086.044139	14.828506	8.054800e+07	1.62
min	1730.000000	1997.000000	0.000000	0.000000	1.000000	4.385000e+03	1.08
25%	98052.000000	2018.000000	0.000000	0.000000	18.000000	1.713098e+08	5.30
50%	98122.000000	2021.000000	17.000000	0.000000	33.000000	2.183278e+08	5.30
75%	98370.000000	2023.000000	84.000000	0.000000	43.000000	2.415062e+08	5.30
max	99577.000000	2024.000000	337.000000	845000.000000	49.000000	4.792548e+08	5.60

Answering Question 2

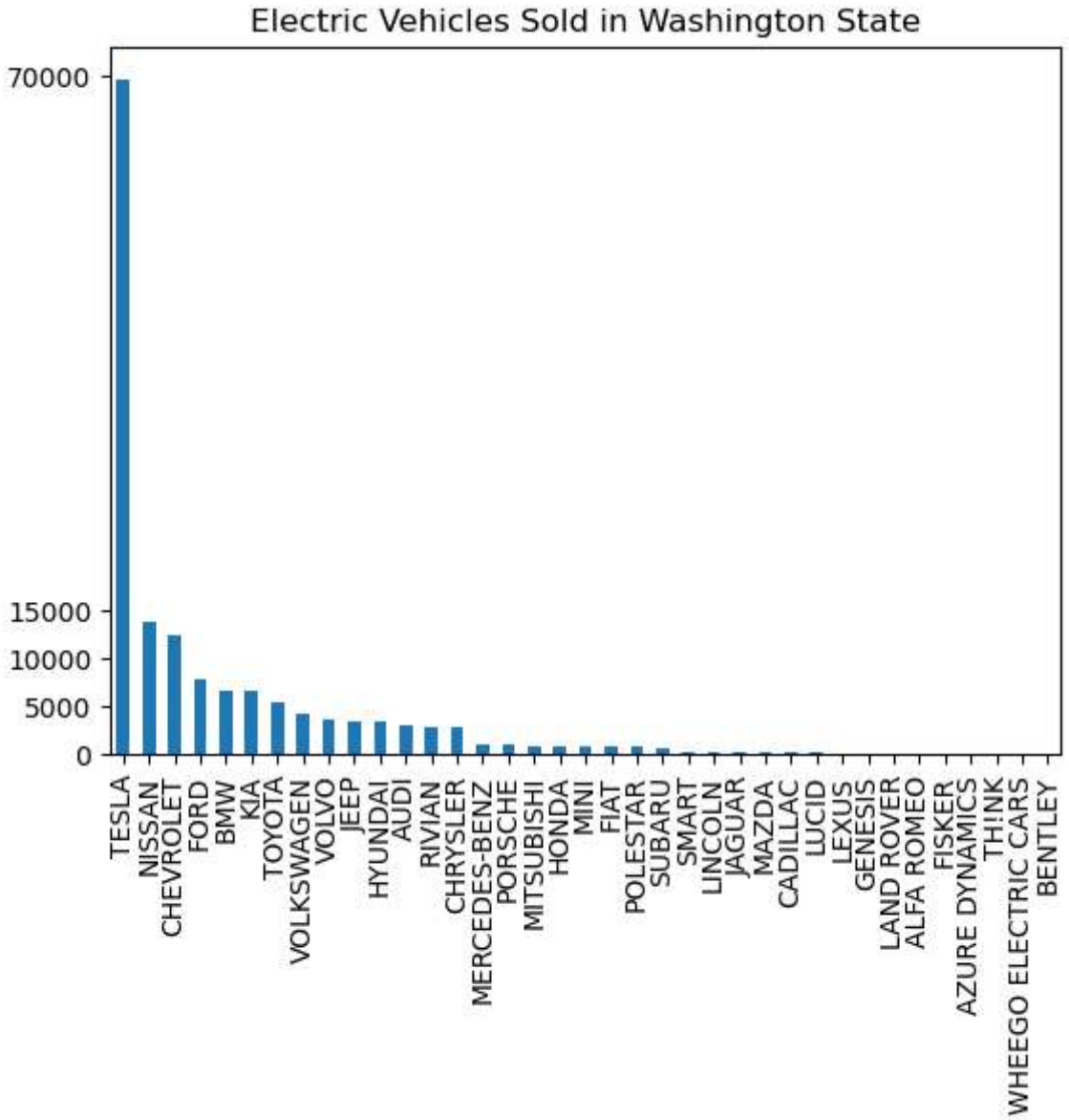
In [31]:
```
tally = dataframe['Make'].value_counts()
tally
```

Out[31]:
```
TESLA                69601
NISSAN               13649
CHEVROLET            12242
FORD                  7817
BMW                   6620
KIA                   6534
TOYOTA                5386
VOLKSWAGEN            4238
VOLVO                 3666
JEEP                  3468
HYUNDAI               3410
AUDI                  3094
RIVIAN                2777
CHRYSLER              2755
MERCEDES-BENZ         1108
PORSCHE               1041
MITSUBISHI             884
HONDA                  818
MINI                   810
FIAT                   797
POLESTAR               782
SUBARU                 640
SMART                  276
LINCOLN                231
JAGUAR                 225
MAZDA                  204
CADILLAC               191
LUCID                  191
LEXUS                  160
GENESIS                117
LAND ROVER              46
ALFA ROMEO              18
FISKER                  17
AZURE DYNAMICS           8
TH!NK                    5
WHEEGO ELECTRIC CARS     3
BENTLEY                  1
Name: Make, dtype: int64
```

Matplotlib Barplot

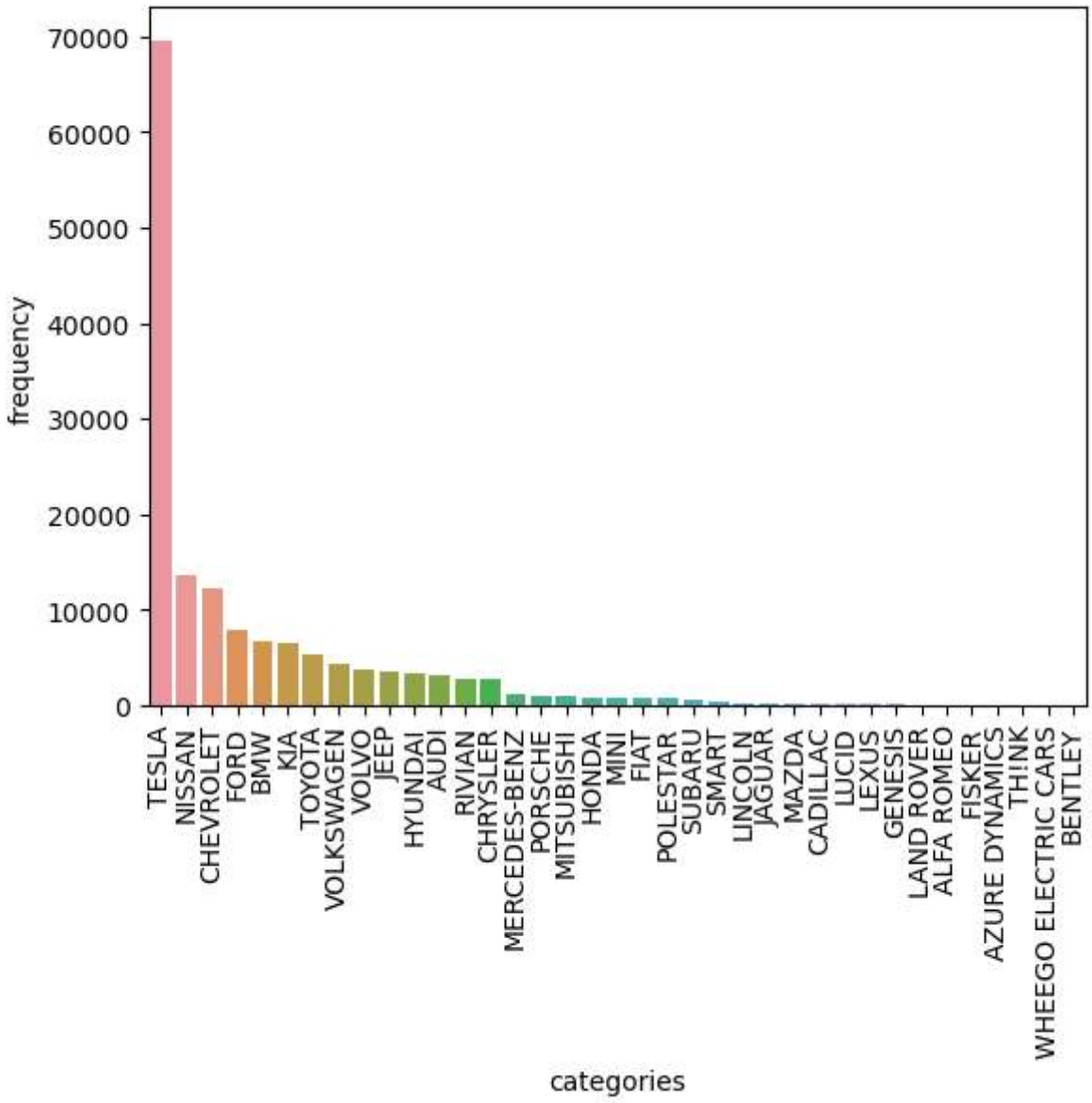
In [39]:
```
# tally.plot(dataframe['Make'].value_counts())
tally.plot(kind='bar', title='Electric Vehicles Sold in Washington State', yticks=[0,
```

Out[39]:
```
<Axes: title={'center': 'Electric Vehicles Sold in Washington State'}>
```



Seaborn Barplot

In [49]:
```
category = dataframe.Make.value_counts()
category_df = category.reset_index()
category_df.columns = ['categories', 'frequency']
seaborn_plot = seaborn.barplot(x = 'categories', y = 'frequency', data = category_df)
for item in seaborn_plot.get_xticklabels():
    item.set_rotation(90)
```



Answering Question 2

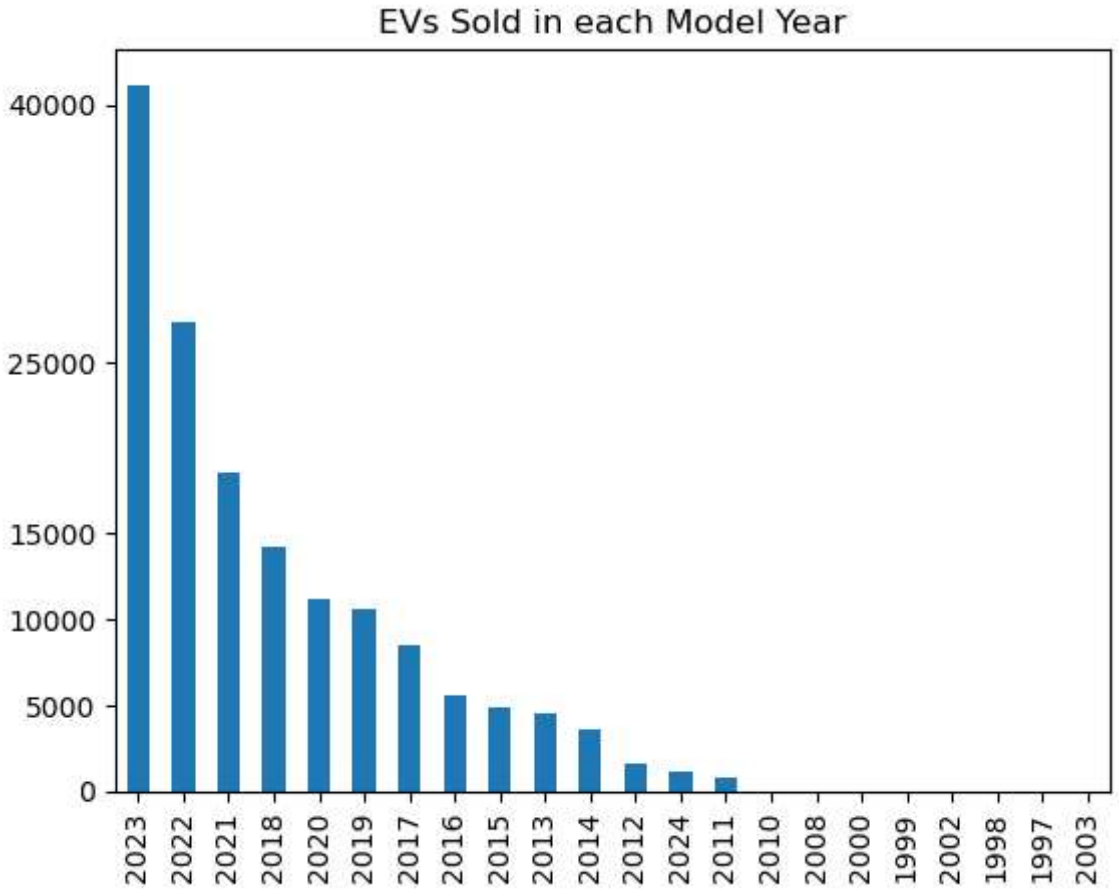
In [53]:
```
tally_model_year = dataframe['Model Year'].value_counts()
tally_model_year
```

Out[53]:
```
2023    41159
2022    27374
2021    18568
2018    14239
2020    11196
2019    10602
2017     8488
2016     5601
2015     4893
2013     4541
2014     3568
2012     1649
2024     1103
2011      789
2010       24
2008       20
2000        8
1999        3
2002        2
1998        1
1997        1
2003        1
Name: Model Year, dtype: int64
```

Matplotlib Barplot (line plot is not displaying properly, but it is the more appropriate type for this data)

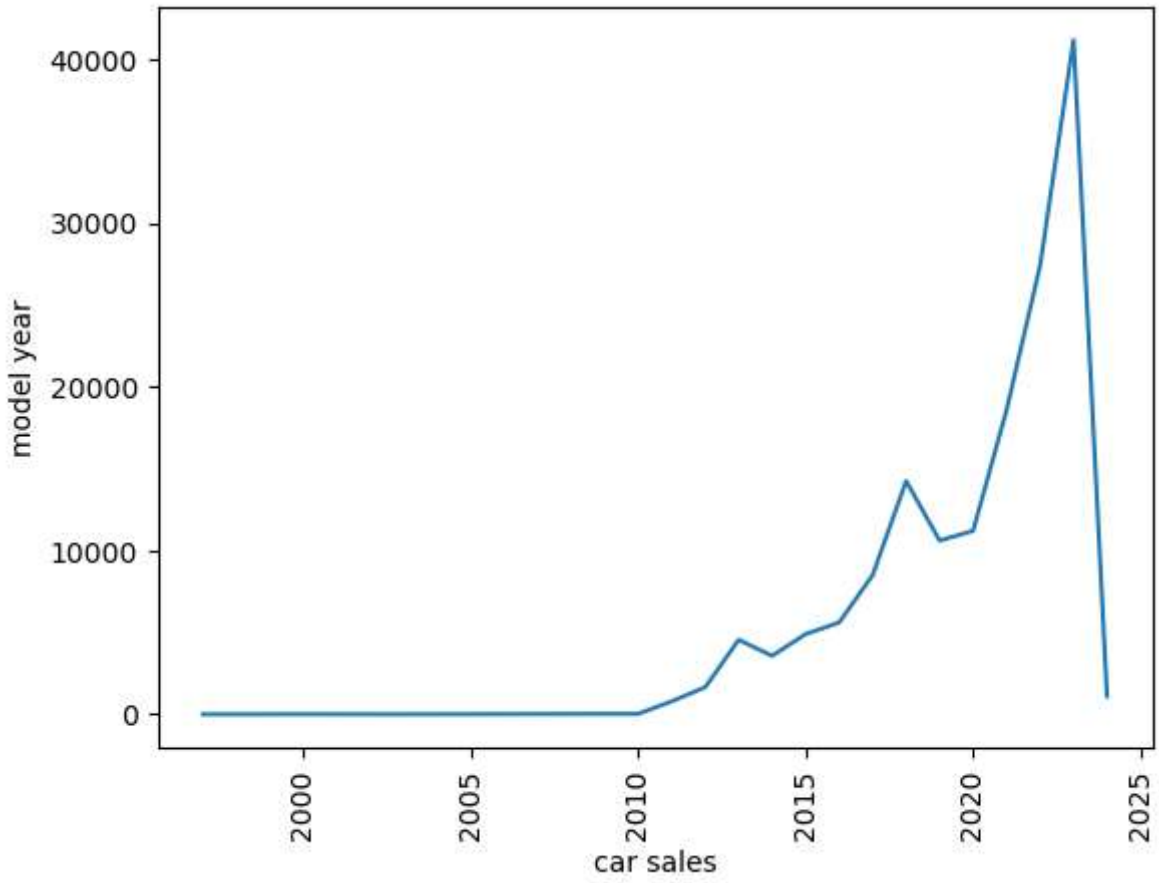
In [69]:
```
tally_model_year.plot(kind='bar',title='EVs Sold in each Model Year', yticks=[0, 5000,
```

Out[69]:
```
<Axes: title={'center': 'EVs Sold in each Model Year'}>
```



Seaborn Lineplot (more appropriate for the use case)

In [80]:
```
category = dataframe['Model Year'].value_counts()
category_df = category.reset_index()
category_df.columns = ['car sales', 'model year']
seaborn_plot = seaborn.lineplot(x = 'car sales', y = 'model year', data = category_df)
for item in seaborn_plot.get_xticklabels():
    item.set_rotation(90)
```



Part 4: Inference (35 Points)

Perform whatever analysis is necessary to answer your research question. Your analysis should include at least one graphic, and for each graphic you create you must do so using both Matplotlib and Seaborn (as described in Part 3 above). Include a narrative explaining your research approach and findings and be sure include any Python code used as part of your work.

Part 5: Conclusion (10 Points)

A brief, concise narrative explaining your conclusions.

References (3 Points)

Be sure to include proper citations for any references you may have relied on as part of your work.

- https://catalog.data.gov/dataset/electric-vehicle-population-data