week6

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1 MIS 492 - Data Analysis and Visualization

1.1 Week 6

1.2 Visualization With Seaborn

1.2.1 Dr. Mohammad AlMarzouq

2 Skills Learned So Far

- Loading data
- Univariate exploration of data to find problems
  - Using simple matplotlibs
- Filteration
- Data manipulation

2.0.1 You can prepare the dataframe that you will perfor EDA on

3 What Is Seaborn?

- Plotting library built on top of matplotlib
- Adds more plotting options
- Simplifies plotting for some complex plots
- Improves the look of matplotlib plots
- Works almost exactly like matplot lib

4 First Install Seaborn

Open Terminal or CMD and type the following command:

```
pip install seaborn
```

```
pip install statsmodels
```

5 Using Seaborn

Just like pandas you have to import it:

```
In [1]: # don't forget this
        %matplotlib inline
        import seaborn as sns

        # Now tell jupyter to use seaborn colors
        sns.set(color_codes=True)
```

6 Load Data Using URL

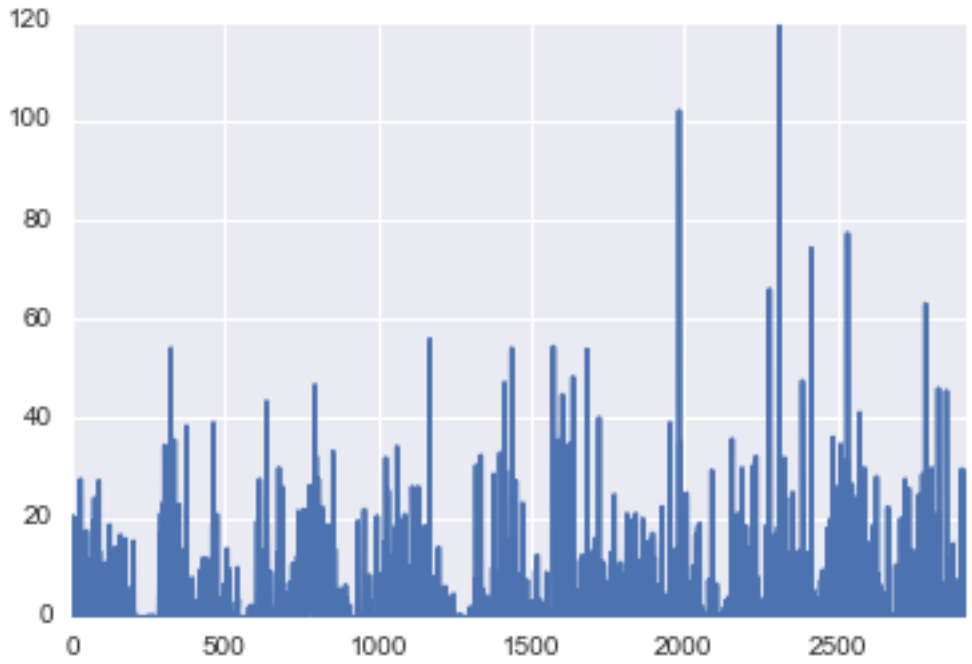
- The url is: https://raw.githubusercontent.com/vega/vega-datasets/gh-pages/data/weather.csv
- Load into weather_df variable
- You can pass the url as a string into pd.read_csv and pandas will download the data:

```
In [101]: import pandas as pd
          weather_df = pd.read_csv("https://raw.githubusercontent.com/vega/vega-datasets/gh-page
```

```
In [9]: # Your turn
        # load https://github.com/vega/vega-datasets/raw/gh-pages/data/cars.json
        # into cars_df
```

```
In [3]: # Try to plot the distribution of the precipitation column
        weather_df.precipitation.plot()
```

```
Out[3]: <matplotlib.axes._subplots.AxesSubplot at 0x1137243c8>
```



```
In [ ]: # What was new about the previous plot?
        # Can you do a histogram of precipitation
```

7 Plots So Far

- Look better with seaborn
- Still univariate only
- Not much control

So let's try to improve

8 General Seaborn/Matplot Workflow

1. Create an empty figure
2. Add single or multiple plots
    - Set the plot type and assign data to axis
3. Modify the aesthetics of the plot (e.g. axis, text, labels, ..etc.)
4. Show/Save the plot

Great for overlaying plots, making customization, and creating trellis/grid plots

9 Simple Seaborn Workflow

- Just set the data to create a single plot

Excellent for quick EDA and allows for some customization

10 CheatSheets

Use these to remind you about the basic workflow - Matplotlib - Seaborn
Source: Datacamp.com

11 Resources

- How matplot lib works
- Matplot tutorials **Excellent resource on how to perform tasks**
- Seaborn Tutorials

12 Univariate Plots (Distributional)

- BarPlot/CountPlot
- Histogram/Distribution plot
- PieChart
- Boxplot
- Violinplot
- Swarmplot
- Stripplot

13 Univariate Plots (Distributional)

- Use these plots to examine the distribution of a single variable
- You can use them also later to compare distributions of two variable or two groups
- To determine which to use, refer again to this cheatsheet as a starting point

Let's examine how the weather_df and cars_df look like:

```
In [5]: # How do we examine weather_df to know what columns exist?
```

```
In [7]: # How do we examine cars_df to know what columns exist?
```

14 Bar Plot/Count Plot

- Best for counting occorances and distribution of categorical data
- Count Plot is the name used in seaborn to distinguish it from the matplot bar plot, but they are the same
- Which columns are best examined using it?

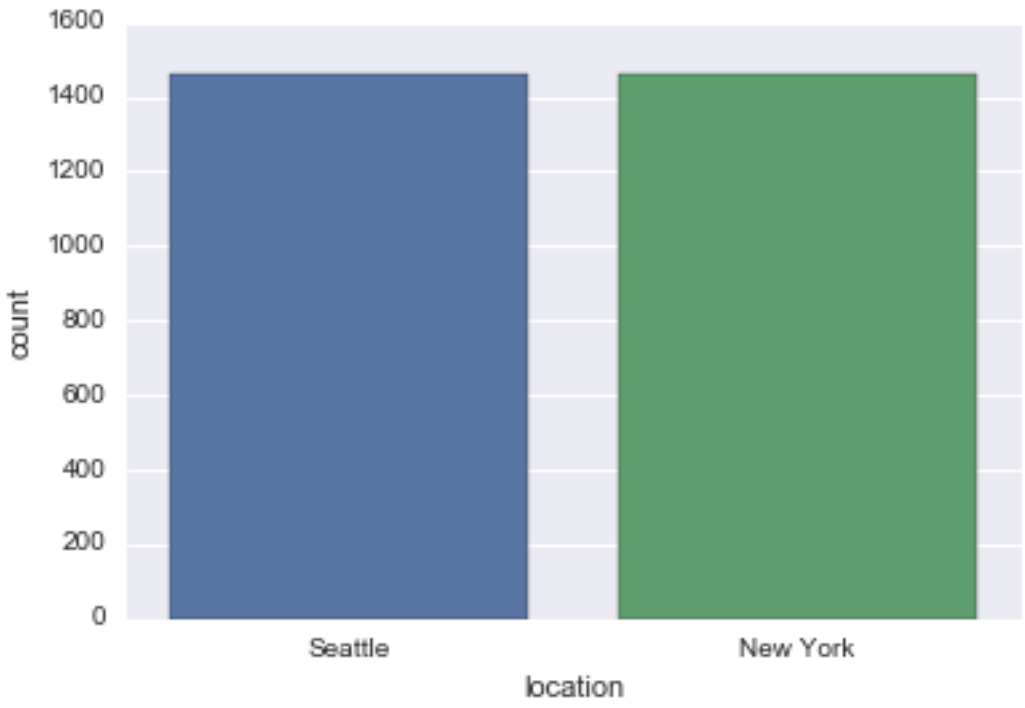
- **weather_df**: Location, Weather
- **cars_df**: Cylinders, Origin, Year.
  - What about Name?

15 How To Use Count Plot

- Check the reference for Count Plot in Seaborn Documentation
- sns.countplot is the function
- Requires data argument, and name of variable to plot
  - Alternatively, you can just pass the variable
- Useful to get count of each category

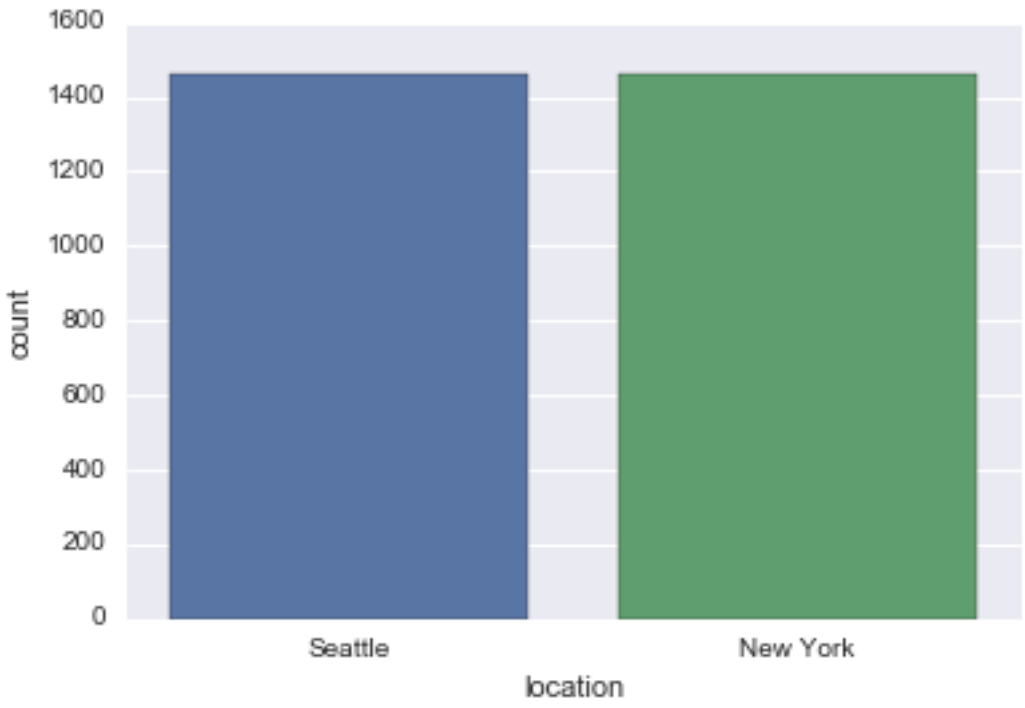
```
In [10]: # BEWARE of case sensitivity, "Location" will not work!
         sns.countplot("location", data=weather_df)
```

```
Out[10]: <matplotlib.axes._subplots.AxesSubplot at 0x1137c2390>
```



16 Saving The Image Is Simple

```
In [11]: # Store the image in a variable:
         cnt_plt = sns.countplot("location", data=weather_df)
         # use saveFig and give the file a name
         cnt_plt.figure.savefig("location_count1")
         # For transparent background use
         cnt_plt.figure.savefig("location_count2", transparent=True)
```

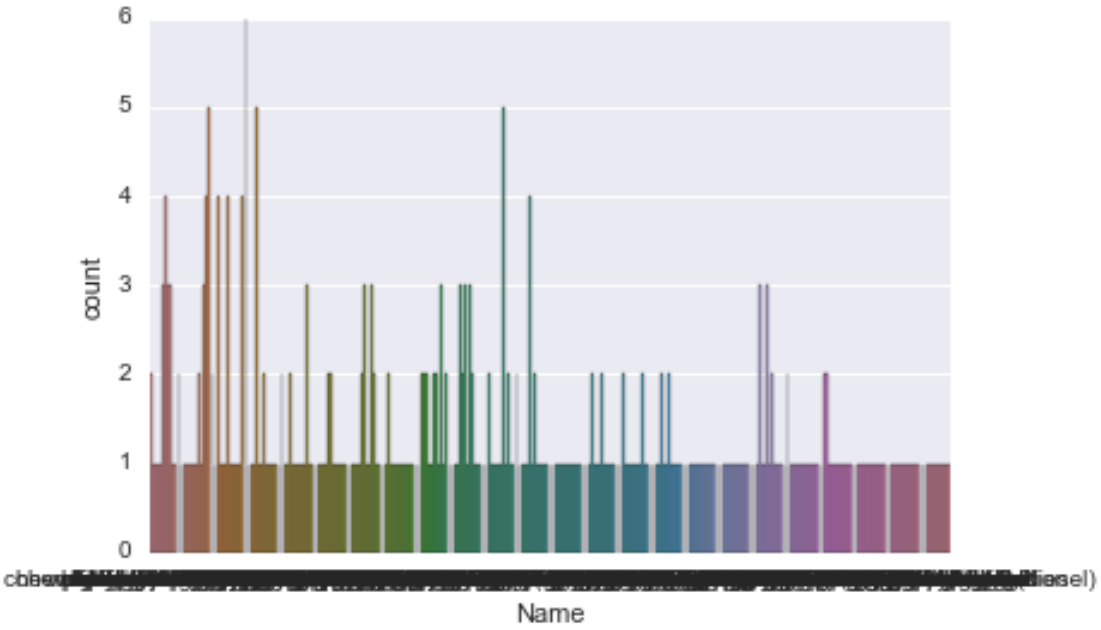



```
In [ ]: # Your turn to examine the distribution of other categorical variables we identified
        # from both weather_df and cars_df
```

17 What About Cars_df.Name?

- Let's try to plot it using countplot and see what the problem is:

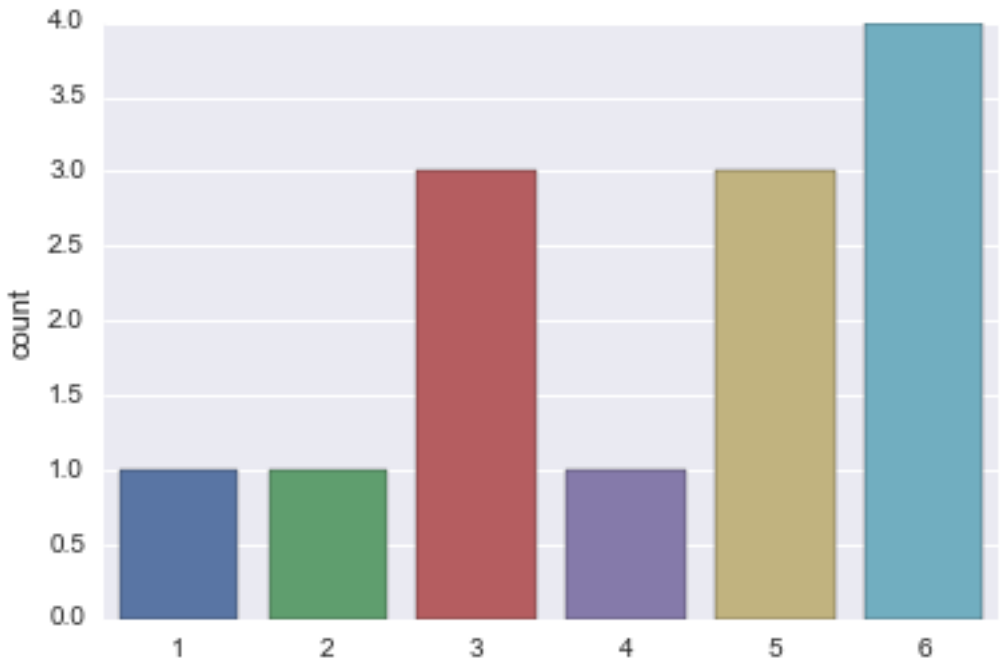
```
In [12]: name_plt = sns.countplot('Name', data=cars_df)
```



18 What Can We Do?

- Problem: Overwhelming plot which we cannot make sense of
- Cause: Many categories
- Solution: Reduce the categories, but how?
  - By getting a subset, we cannot work with all the data in this case
  - Must use meaningful criteria, for example:
    - Sort the data based on count, then filter by eamining the top/bottom 5 or 10

```
In [13]: # But first, notice how countplot works
         data = [1,2,3,3,3,4,5,5,5,6,6,6,6]
         names_plt = sns.countplot(data)

         # CountPlot will do the counting of the categories for you
```



In [14]:
```
# Look at cars_df.Name
cars_df.Name

# It is just a list of names (Pandas calls it series)
# CountPlot is able to count them but the image is not readable
```

Out[14]:
```
0                chevrolet chevelle malibu
1                        buick skylark 320
2                       plymouth satellite
3                            amc rebel sst
4                              ford torino
5                         ford galaxie 500
6                         chevrolet impala
7                        plymouth fury iii
8                         pontiac catalina
9                       amc ambassador dpl
10                    citroen ds-21 pallas
11      chevrolet chevelle concours (sw)
12                        ford torino (sw)
13                  plymouth satellite (sw)
14                       amc rebel sst (sw)
15                     dodge challenger se
16                      plymouth 'cuda 340
17                   ford mustang boss 302
18                   chevrolet monte carlo
```

```
19                buick estate wagon (sw)
20                  toyota corona mark ii
21                        plymouth duster
22                             amc hornet
23                          ford maverick
24                           datsun pl510
25           volkswagen 1131 deluxe sedan
26                            peugeot 504
27                            audi 100 ls
28                               saab 99e
29                               bmw 2002
                     ...
376               chevrolet cavalier wagon
377              chevrolet cavalier 2-door
378            pontiac j2000 se hatchback
379                        dodge aries se
380                       pontiac phoenix
381                  ford fairmont futura
382                        amc concord dl
383                  volkswagen rabbit l
384                   mazda glc custom l
385                     mazda glc custom
386                plymouth horizon miser
387                        mercury lynx l
388                      nissan stanza xe
389                honda Accelerationord
390                        toyota corolla
391                           honda civic
392                     honda civic (auto)
393                           datsun 310 gx
394                buick century limited
395    oldsmobile cutlass ciera (diesel)
396            chrysler lebaron medallion
397                        ford granada l
398                      toyota celica gt
399                     dodge charger 2.2
400                      chevrolet camaro
401                      ford mustang gl
402                            vw pickup
403                        dodge rampage
404                          ford ranger
405                           chevy s-10
Name: Name, Length: 406, dtype: object
```

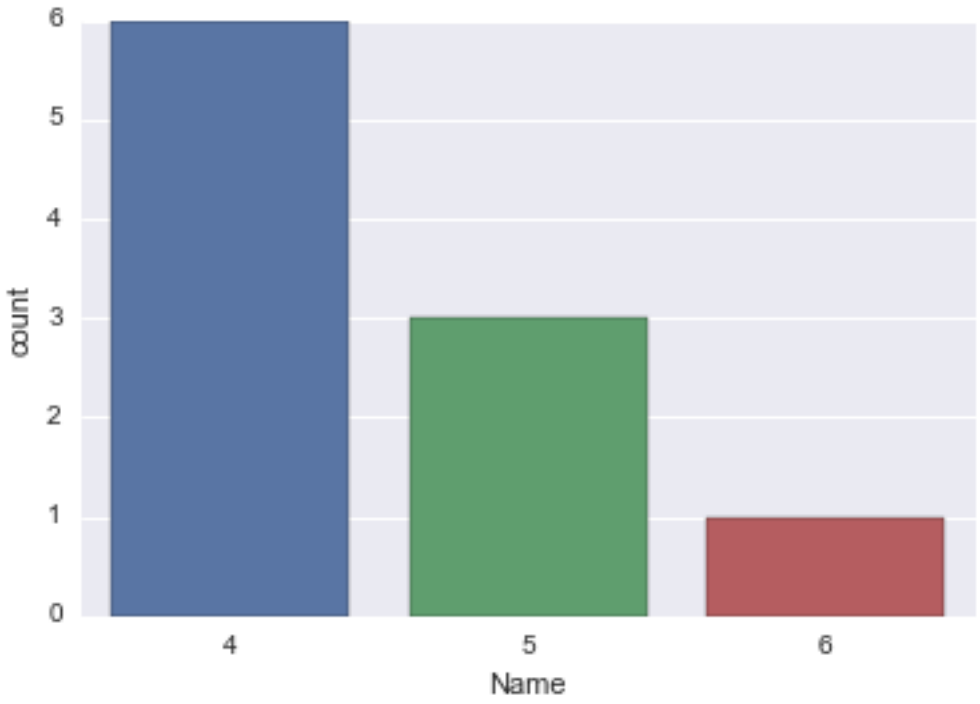
In [15]:
```
# Let's get the name count and filter the top ten
# Let's see how the data looks like
cars_df.Name.value_counts()[:10]
```

Out[15]:
```
ford pinto            6
```

```
amc matador           5
ford maverick         5
toyota corolla        5
toyota corona         4
chevrolet chevette    4
peugeot 504           4
chevrolet impala      4
amc hornet            4
amc gremlin           4
Name: Name, dtype: int64
```

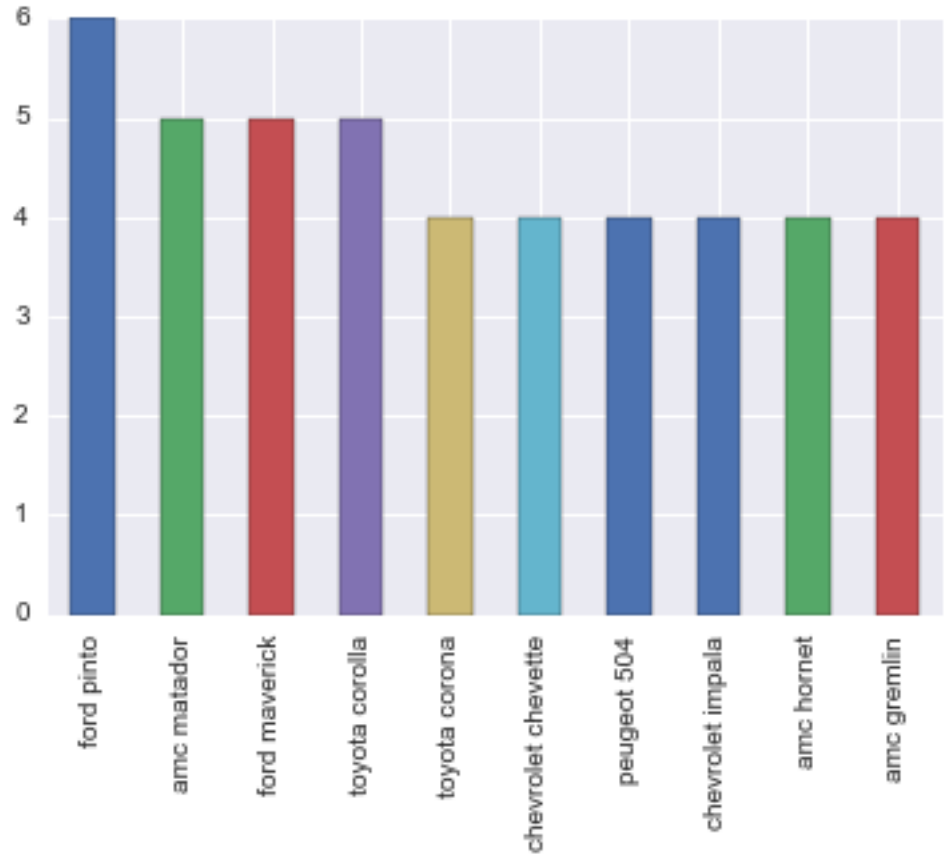
In [16]:
```
# CountPlot doesnt work well with value-count data
# If we use it, it will count the numbers for us
# and find the times 6s, 5s, and 4s occured
data = cars_df.Name.value_counts()[:10]
sns.countplot(data)
```

Out[16]: <matplotlib.axes._subplots.AxesSubplot at 0x11864d198>



In [17]:
```
# Instead use simply bar plot from matplot lib
# after filtering topten from value_counts

cars_df.Name.value_counts()[:10].plot(kind="bar")

# What can you tell from this plot?
```

Out[17]: <matplotlib.axes._subplots.AxesSubplot at 0x11862a710>



19 Distribution Plot

- Useful to look at the distribution of values for a continuous or numeric variable
- Named a distribution plot to distinguish it from the matplot lib histogram, but they are the same
- Which variables can we plot using it?

In [18]:
```
weather_df.head()
```

Out[18]:

	location	date	precipitation	temp_max	temp_min	wind	weather
0	Seattle	2012-01-01 00:00	0.0	12.8	5.0	4.7	drizzle
1	Seattle	2012-01-02 00:00	10.9	10.6	2.8	4.5	rain
2	Seattle	2012-01-03 00:00	0.8	11.7	7.2	2.3	rain
3	Seattle	2012-01-04 00:00	20.3	12.2	5.6	4.7	rain
4	Seattle	2012-01-05 00:00	1.3	8.9	2.8	6.1	rain

In [19]:
```
cars_df.head()
```

Out[19]:

	Acceleration	Cylinders	Displacement	Horsepower	Miles_per_Gallon	\
0	12.0	8	307.0	130.0	18.0	
1	11.5	8	350.0	165.0	15.0	
2	11.0	8	318.0	150.0	18.0	
3	12.0	8	304.0	150.0	16.0	
4	10.5	8	302.0	140.0	17.0	

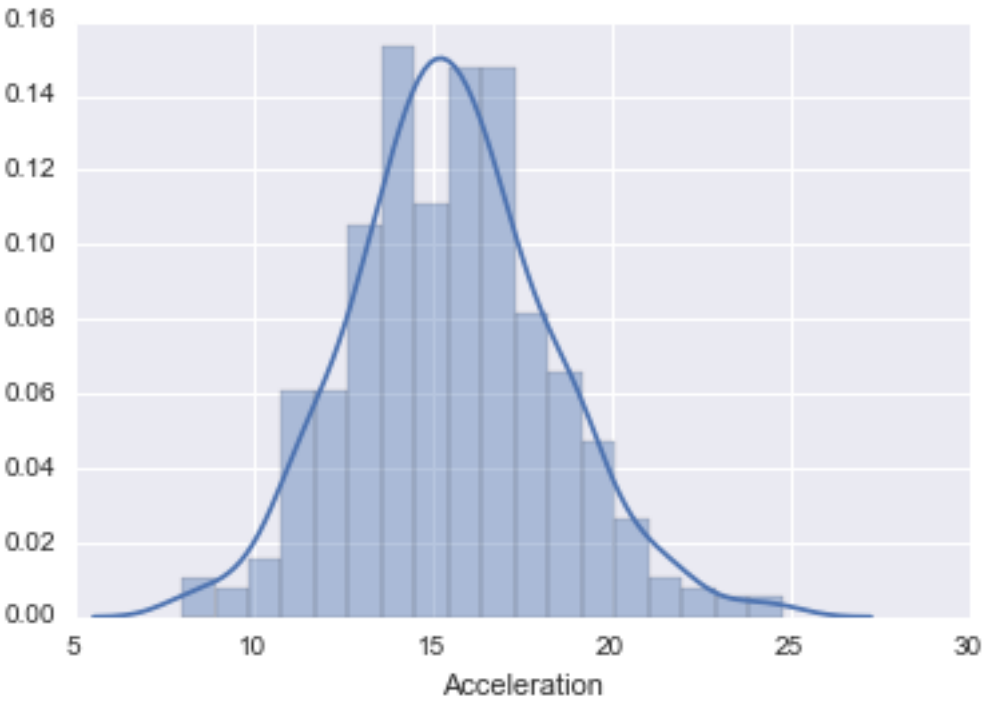
	Name	Origin	Weight_in_lbs	Year
0	chevrolet chevelle malibu	USA	3504	1970-01-01
1	buick skylark 320	USA	3693	1970-01-01
2	plymouth satellite	USA	3436	1970-01-01
3	amc rebel sst	USA	3433	1970-01-01
4	ford torino	USA	3449	1970-01-01

20 Distribution Plot

- weather_df: precipitation, temp_max, temp_min, wind
- cars_df: Acceleration, Displacement, Horsepower, Miles_per_Gallon, Weight_in_lbs
  - Why isn't Cylinders included here?

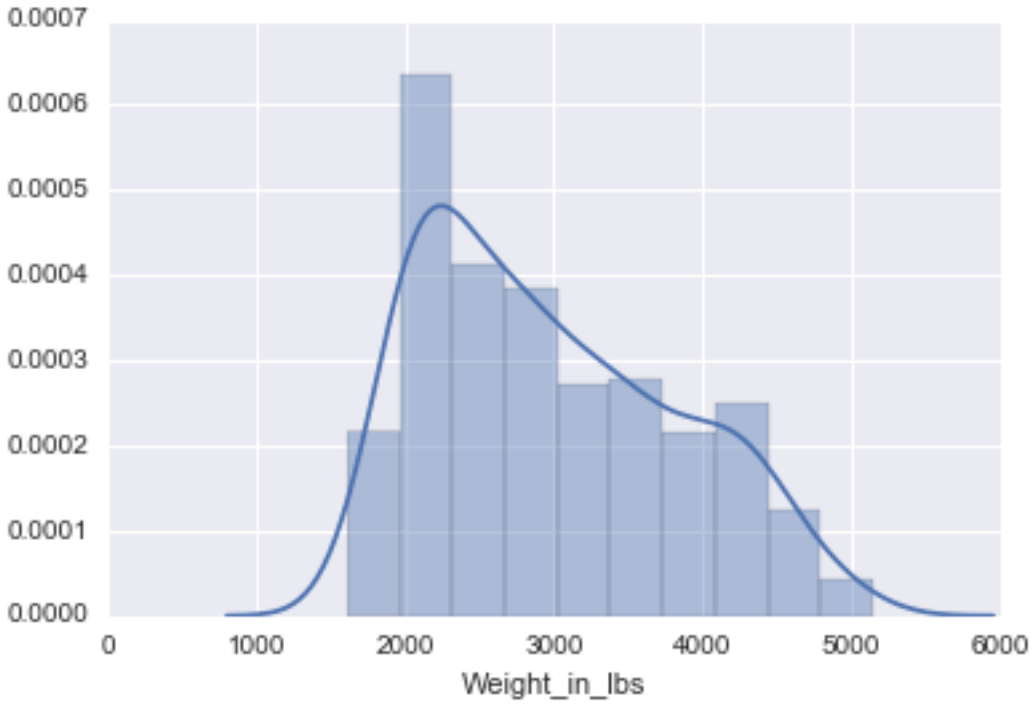
In [20]:
```
sns.distplot(cars_df.Acceleration)

# Add the argument kde=False to remove the distribution line
# you can set the range of values in each bar
# using bins argument
```

Out[20]: <matplotlib.axes._subplots.AxesSubplot at 0x1188189b0>



```
In [22]: # Here is the distribution of another variable
         sns.distplot(cars_df.Weight_in_lbs)
```

```
Out[22]: <matplotlib.axes._subplots.AxesSubplot at 0x118ffa668>
```



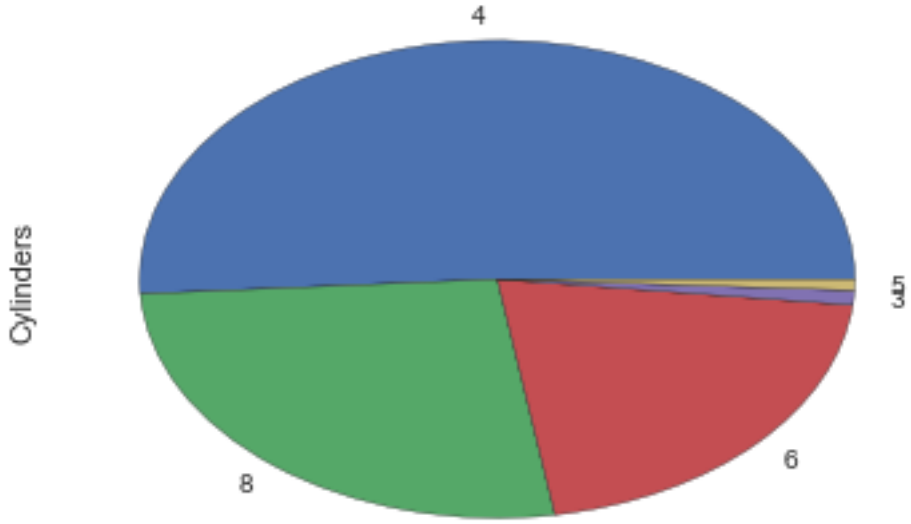

```
In [47]: # try to plot cars_df.Horsepower
         # What is the problem?
         # how can we fix it? (2 solutions available)
```

21 Pie Chart

- Used to represent proportinos of **categorical** variables
- Available in Matplotlin

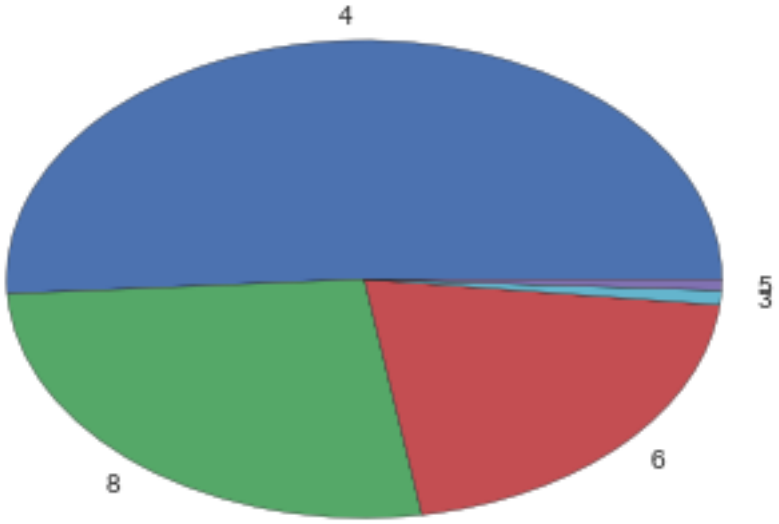
```
In [51]: cars_df.Cylinders.value_counts().plot(kind="pie")
```

```
Out[51]: <matplotlib.axes._subplots.AxesSubplot at 0x11a4c14e0>
```




```
In [66]: # another way of doing it with matplot lib
         import matplotlib.pyplot as plt
         plt.pie(cars_df.Cylinders.value_counts(), labels=cars_df.Cylinders.value_counts().index
```

```
Out[66]: ([<matplotlib.patches.Wedge at 0x119c8bb38>,
           <matplotlib.patches.Wedge at 0x119c907f0>,
           <matplotlib.patches.Wedge at 0x119c96470>,
           <matplotlib.patches.Wedge at 0x119c9a0f0>,
           <matplotlib.patches.Wedge at 0x119c9ad30>],
          [<matplotlib.text.Text at 0x119c90358>,
           <matplotlib.text.Text at 0x119c90f98>,
           <matplotlib.text.Text at 0x119c96c18>,
           <matplotlib.text.Text at 0x119c9a898>,
           <matplotlib.text.Text at 0x119c9e518>])
```

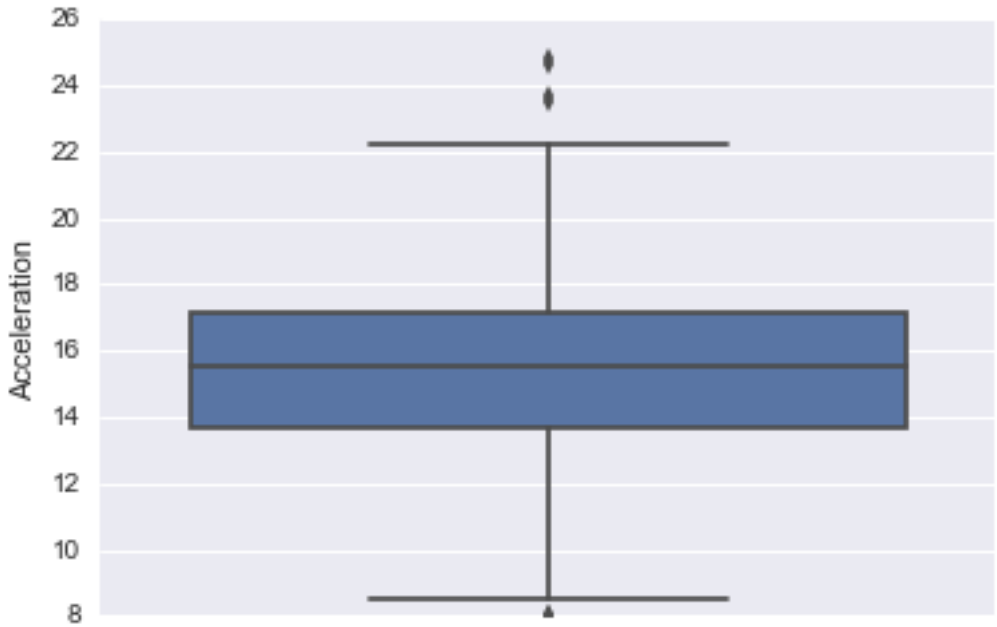


22 BoxPlot

- One of the original plots for EDA
- Used with continuous variables
- Gives an idea about distribution/skewness of data
- Inter-Quartile Range (IQR in the both (1st to 3rd quartiles)
- Shows possible outliers (above/below 1.5*IQR)
- Shows outliers (above/below 3*IQR)
- Used best to compare distributions of variables or subgroups

```
In [77]: # orient can be 'v' or 'h
         sns.boxplot(cars_df.Acceleration, orient='v')
```

```
Out[77]: <matplotlib.axes._subplots.AxesSubplot at 0x11c5edc50>
```



23 Your Turn

Explore the seaborn documentation and try to plot the categorical variables using: - Violin Plot - Swarm Plot - Strip Plot

```
In [78]: # Your work here
         # You can add cells as needed
```

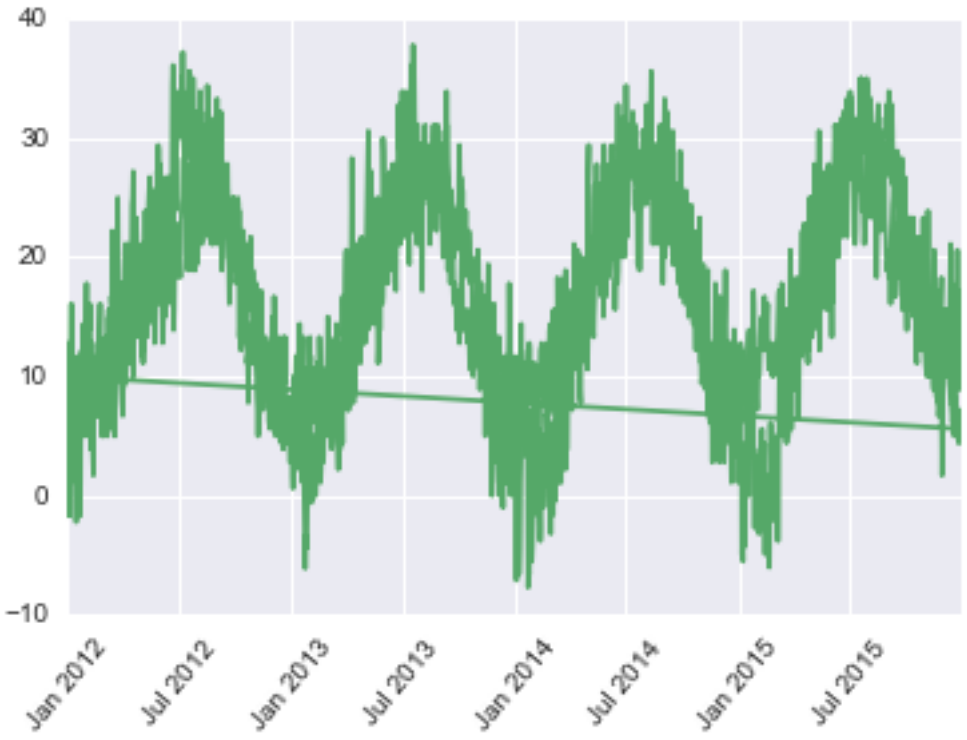
24 Time Series

- Time series is data that changes over time
- When plotting such data, the value is placed in the Y axis with the time value on the X axis
- Time can be period, day, date, week, month, year ..etc
- Time values will be ordered

25 Plotting Time Series

- Typically, line plots or scatter plots can be used
- Possible to use other plots if they make sense and can show the message you are trying to convey
  - Experiment to see what you can do
- You can use seaborn tsplot, but it will be removed in the future
- Use matplotlib plot_date

```
In [129]: # But first, remember to convert the date field to datetime object
          weather_df.date = pd.to_datetime(weather_df.date)

In [130]: # to rotate the date by 50 degrees
          plt.xticks(rotation=50)

          plt.plot_date(x=weather_df.date, y=weather_df.temp_max, fmt='g-')

Out[130]: [<matplotlib.lines.Line2D at 0x11a3244a8>]
```



26 What is the fmt part?

- Allows you to control how the values are drawn on the plot
- You can set shapes, lines, and colors
- `fmt='g-'` means green solid line
- Remove it and run the plot again, see what happens

27 Example of fmt Strings

Character	Description
'-'	solid line style

Character	Description
'--'	dashed line style
'-.'	dash-dot line style
':'	dotted line style
'.'	point marker
','	pixel marker
'o'	circle marker

- Complete list can be found here
- You can even set the color

28 Your Turn

Examin the documentation for seaborn on aesthetics and matplotlib tutorials to modify the plots that we have made so far. Specifically, you need to select 4 different plot from above and perform the following: - Change the labels - Change the ticks - Change the title of the plot - Change the date format of a time series plot to be Day-Month - Hint: see this discussion on how to do it - Change the ticks - Change the color pallet and style - **Bonus:** Try to add arrows and text to point at data points in the graph

```
In [1]: # Your work here
        # don't forget to move the plots you will work on here
```