Lab 5

September 30, 2021

1 Lab 5

In this lab we discuss scatterplots and how we can measure the linear correlation between two variables.

1.1 Import necessary Python libraries

scipy.stats: https://docs.scipy.org/doc/scipy/reference/stats.html

[1]:

```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
from scipy import stats
```

1.2 Import the data

[2]:

```
# Read .csv data
auto = pd.read_csv("auto.csv")
# The data is a subset of the Auto dataset available at:
# https://archive.ics.uci.edu/ml/datasets/auto+mpg
# The head() function is used to get the first 5 rows.
auto.head()
```

[2]:

```
    mpg  horsepower  weight    origin                       name
0  18.0         130    3504  American  chevrolet chevelle malibu
1  15.0         165    3693  American          buick skylark 320
2  18.0         150    3436  American         plymouth satellite
3  16.0         150    3433  American              amc rebel sst
4  17.0         140    3449  American                ford torino
```

Variable description

mpg: miles per gallon horsepower: Engine horsepower weight: Vehicle weight (lbs.) origin: Origin of car (American, European, Japanese) name: Vehicle name

[3]:

```
# The tail() function is used to get the last 5 rows.
auto.tail()
```

```
[3]:       mpg  horsepower  weight    origin              name
     387  27.0          86    2790  American  ford mustang gl
     388  44.0          52    2130  European         vw pickup
     389  32.0          84    2295  American     dodge rampage
     390  28.0          79    2625  American       ford ranger
     391  31.0          82    2720  American        chevy s-10
```

```
[4]: # Finding the size of the dataset
     # Our dataset has 392 rows and 5 columns.
     auto.shape
```

```
[4]: (392, 5)
```

```
[5]: # Finding the type of each variable
     auto.dtypes
```

```
[5]: mpg           float64
     horsepower      int64
     weight          int64
     origin         object
     name           object
     dtype: object
```

```
[6]: # We should convert any obvious categorical variables to categories.
     # "name" and "origin" are categorical variables in our dataset.
     auto['name'] = auto['name'].astype('category')
     auto['origin'] = auto['origin'].astype('category')
     auto.dtypes
```

```
[6]: mpg            float64
     horsepower       int64
     weight           int64
     origin        category
     name          category
     dtype: object
```

```
[7]: auto.describe() # calculating summary statistics for the quantitative variables
```

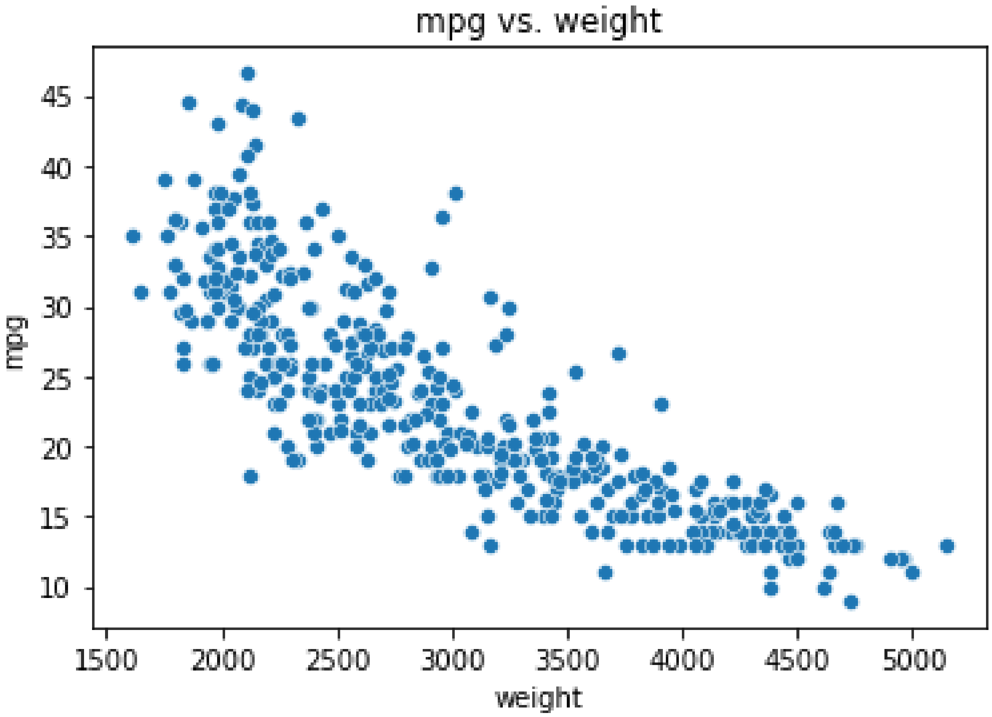
```
[7]:               mpg  horsepower       weight
     count  392.000000  392.000000   392.000000
     mean    23.445918  104.469388  2977.584184
     std      7.805007   38.491160   849.402560
     min      9.000000   46.000000  1613.000000
     25%     17.000000   75.000000  2225.250000
     50%     22.750000   93.500000  2803.500000
     75%     29.000000  126.000000  3614.750000
     max     46.600000  230.000000  5140.000000
```

1.3 Scatterplots

sns.scatterplot: https://seaborn.pydata.org/generated/seaborn.scatterplot.html

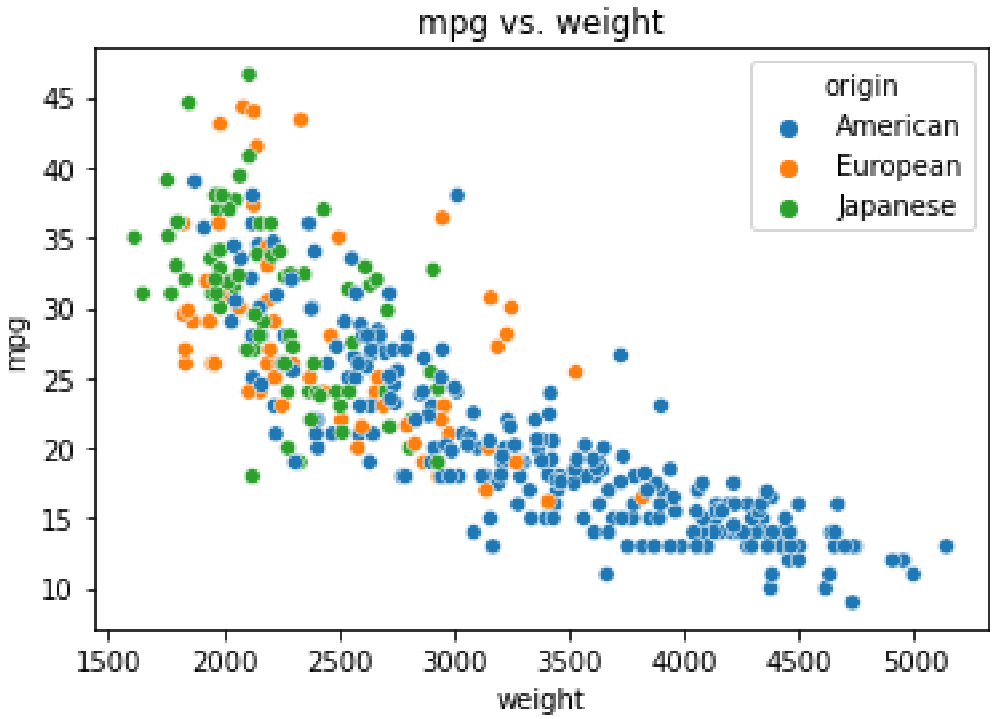
[8]:

```
# Scatter plots are used to observe relationships between variables.
# In the scatterplot the x axis is generally the name of a predictor/
 ↪independent variable.
# In the scatterplot the y axis is generally the name of a response/dependent␣
 ↪variable.
# It can be seen that there is a negative relationship between "mpg" (miles per␣
 ↪gallon) and "weight".
# The heavier the car fewer miles per gallon it will make.
sns.scatterplot(x = "weight", y = "mpg", data = auto)
plt.title("mpg vs. weight")
plt.show()
```

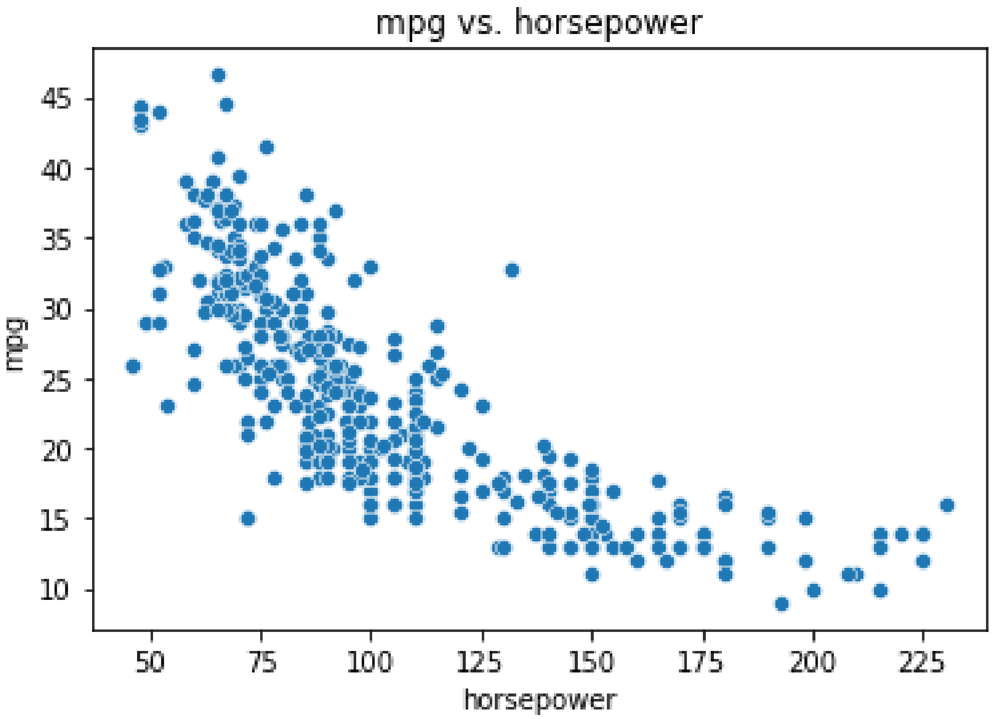


[9]:

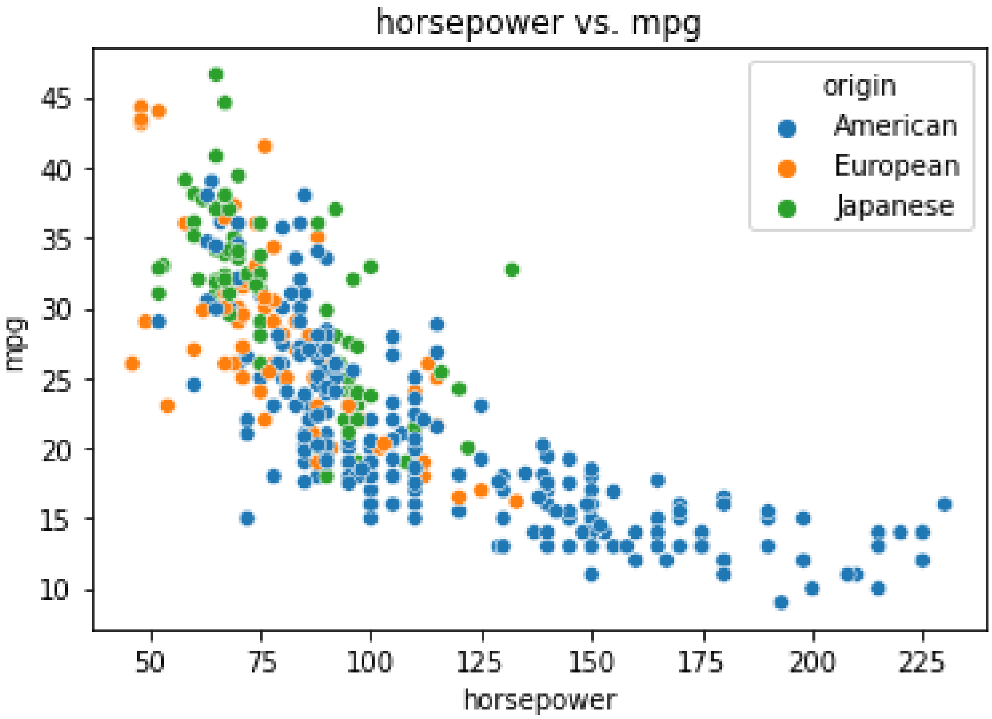
```
# coloring the points according to the origin of the car
sns.scatterplot(x = "weight", y = "mpg", hue = 'origin', data = auto)
plt.title("mpg vs. weight")
plt.show()
```



[10]:
```
sns.scatterplot(x = "horsepower", y = "mpg", data = auto)
plt.title("mpg vs. horsepower")
plt.show()
```

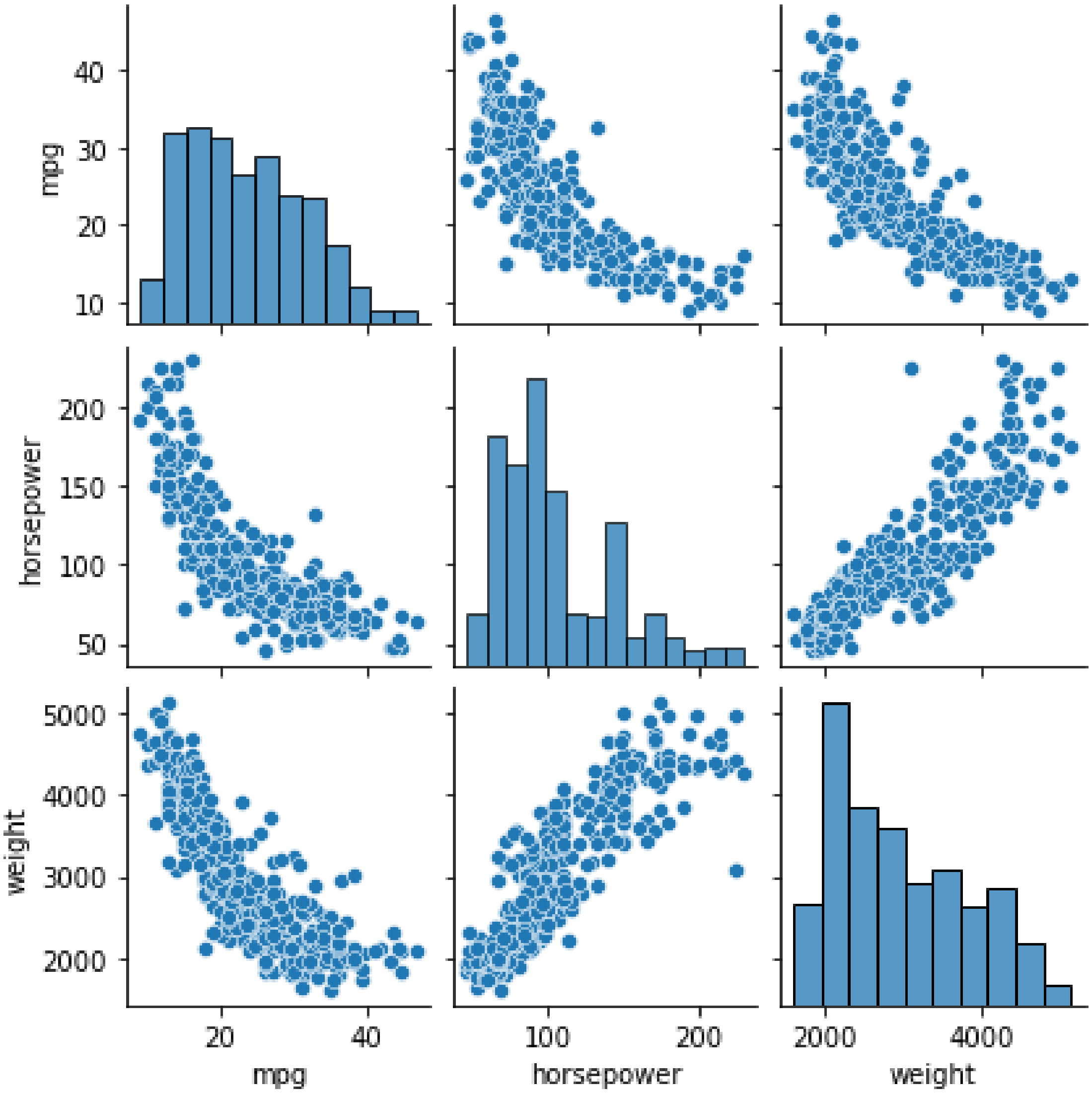


[11]:
```
sns.scatterplot(x = "horsepower", y = "mpg", hue = "origin", data = auto)
plt.title("horsepower vs. mpg")
plt.show()
```



sns.pairplot: https://seaborn.pydata.org/generated/seaborn.pairplot.html

[12]:
```
# The pairplot shows the scatterplots between all pairs of quantitative variables in a dataset.
# It also shows the histogram of each individual variable.
sns.pairplot(auto, height = 2, kind = 'scatter')
plt.show()
```



1.4 Correlation coefficient *r*

stats.pearsonr: https://docs.scipy.org/doc/scipy/reference/generated/scipy.stats.pearsonr.html

[13]:
```
# The Pearson correlation coefficient is a single number that describes the␣
 ↪extent
# of the linear relationship between two variables.
# The coefficient varies between -1 and +1 with 0 implying no correlation.
# Correlations of -1 or +1 imply an exact linear relationship.
# Positive correlations imply that as x increases, so does y.
# Negative correlations imply that as x increases, y decreases.
# It seems there is a strong negative correlation between "weight" and "mpg".
r = stats.pearsonr(auto['mpg'], auto['weight'])[0]
```

```
r
```

```
[13]: -0.8322442148315755
```

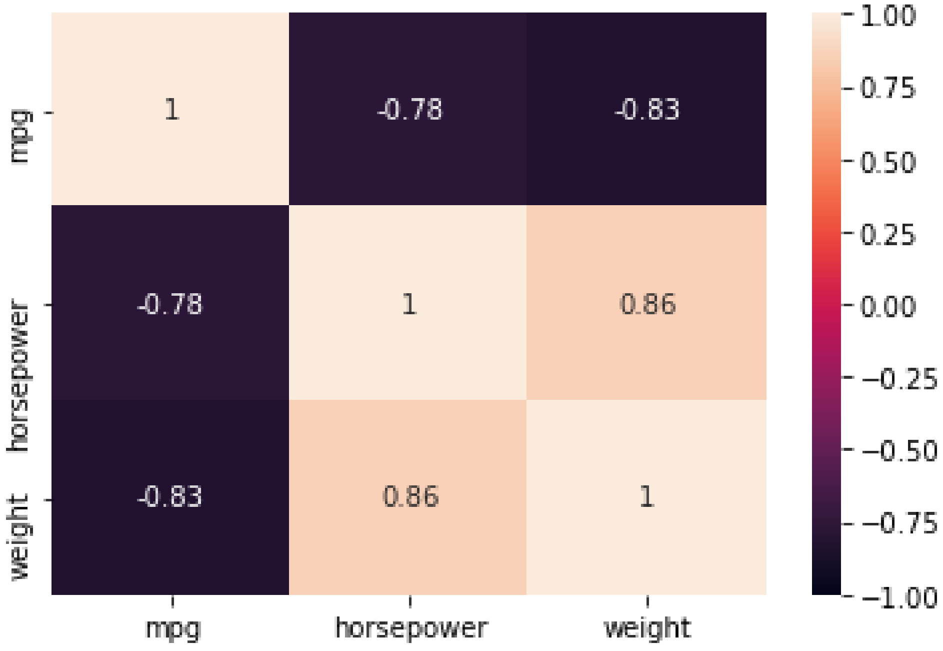
DataFrame.corr: https://pandas.pydata.org/pandas-docs/stable/reference/api/pandas.DataFrame.corr.html

```
[14]: # A correlation matrix can be used to show the correlation coefficient between
      # all pairs of quantitative variables in a dataset.
      # Every correlation matrix is symmetrical.
      # The correlation between each variable and itself is 1, hence the diagonal.
      corr_matrix = auto.corr(method = 'pearson')
      round(corr_matrix, 2)
```

```
[14]:              mpg  horsepower  weight
      mpg         1.00       -0.78   -0.83
      horsepower -0.78        1.00    0.86
      weight     -0.83        0.86    1.00
```

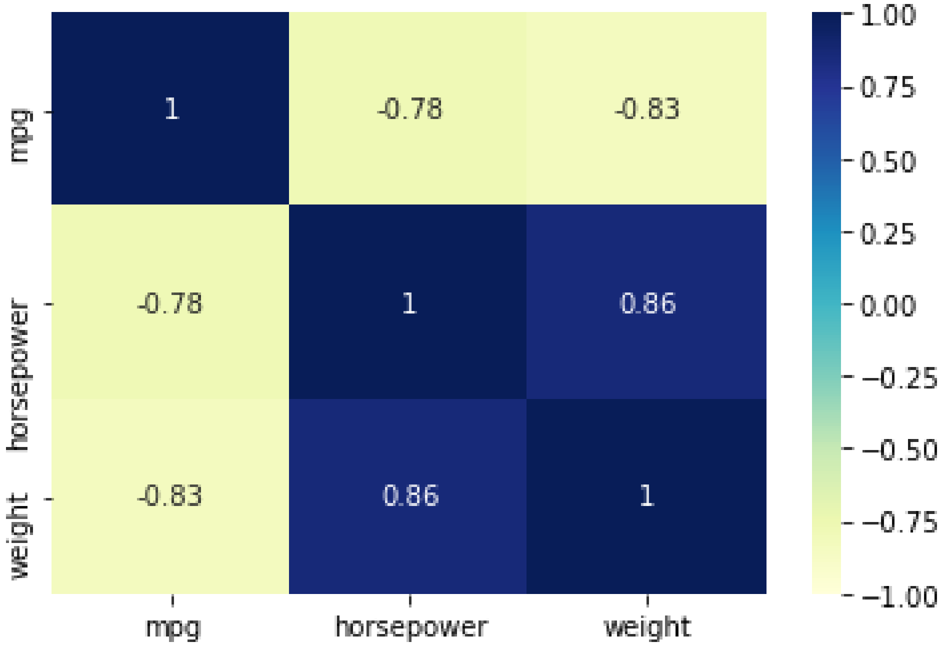
sns.heatmap: https://seaborn.pydata.org/generated/seaborn.heatmap.html

```
[15]: # Heatmaps replace numbers with colors of varying shades, as indicated by the␣
       ↪scale on the right.
      # This type of visualization can make it easier to spot linear relationships␣
       ↪between variables than a table of numbers.
      sns.heatmap(corr_matrix, vmin = -1, vmax = 1, annot = True)
      plt.show()
```



[16]:

```
# heatmap with a different color scheme
sns.heatmap(corr_matrix, vmin = -1, vmax = 1, annot = True,cmap="YlGnBu")
plt.show()
```



[ ]:

```

```