Lab 6

October 7, 2021

1 Lab 6

In this lab we discuss statistical modelling and least squares regression.

1.1 Simple Linear Regression

[1]:

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

[2]:

```
# Read .csv data
possum = pd.read_csv("possum.csv")
# The possum dataset consists of morphometric measurements on 46 possums.
possum.head()
```

[2]:

```
  sex  age  headL  skullW  totalL  tailL
0   m    8   94.1    60.4    89.0   36.0
1   f    6   92.5    57.6    91.5   36.5
2   f    6   94.0    60.0    95.5   39.0
3   f    6   93.2    57.1    92.0   38.0
4   f    2   91.5    56.3    85.5   36.0
```

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

[3]:

```
# Building a simple model with only one term
# Simple linear regression is a linear regression model with a single␣
 ↪explanatory variable.
model = stats.linregress(x = possum['age'], y = possum['headL'])
```

[4]:

```
# Finding the slope of the regression line
model.slope
```

[4]:

```
0.5631158455392805
```

[5]:

```
# Finding the intercept of the regression line
model.intercept
```

[5]:

```
90.08288948069242
```

[6]:

```
# Finding the correlation coefficient (R)
model.rvalue
```

[6]:

```
0.4011016610119052
```

[7]:

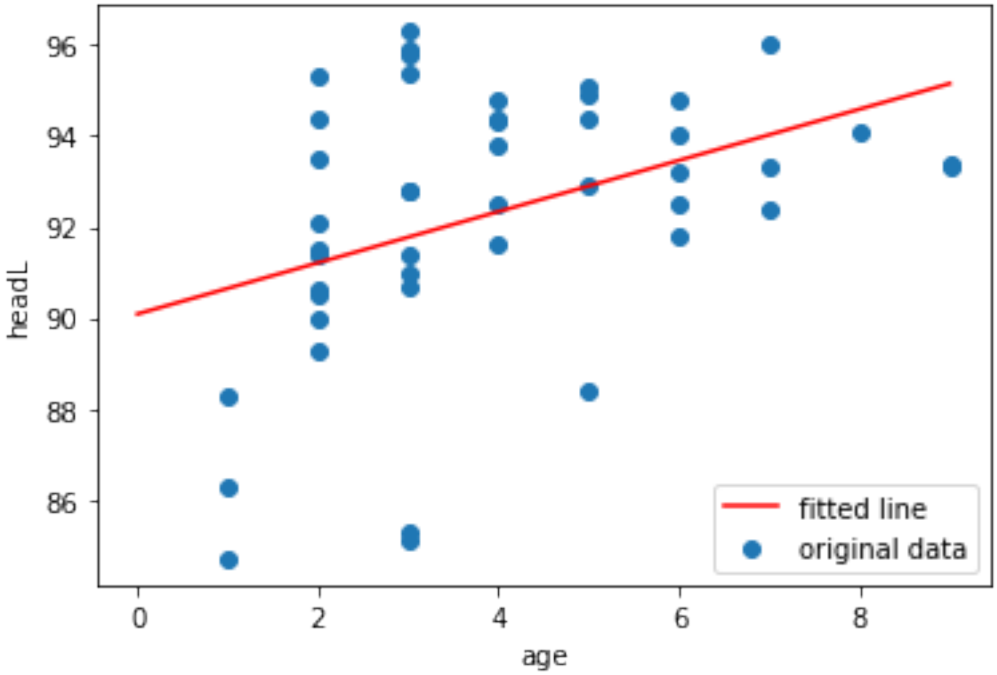
```
# Calculating the R-squared
(model.rvalue ** 2)
```

[7]:

```
0.16088254246650932
```

[8]:

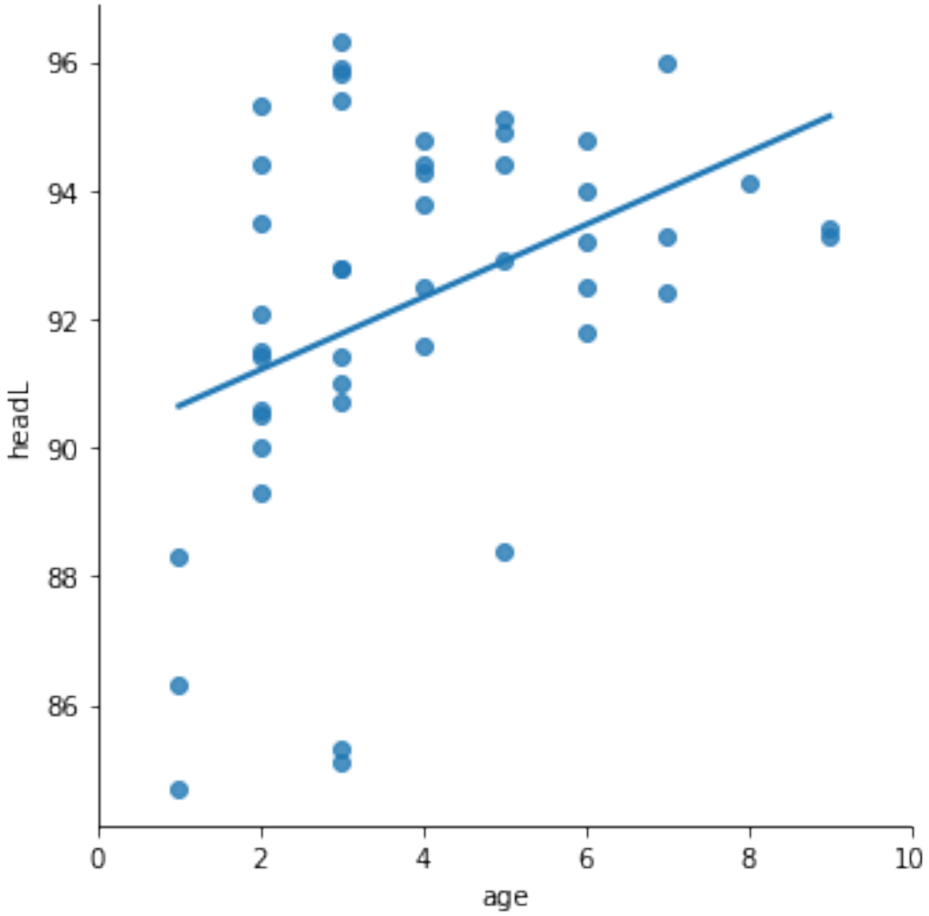
```
# Plotting the fitted line
X = pd.DataFrame({"age":np.linspace(0, 9, 45)})
y_pred = model.intercept + model.slope * X
plt.scatter(possum['age'], possum['headL'], label = 'original data')
plt.plot(X, y_pred, color = 'red', label = 'fitted line')
plt.xlabel("age")
plt.ylabel("headL")
plt.legend()
plt.show()
```



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

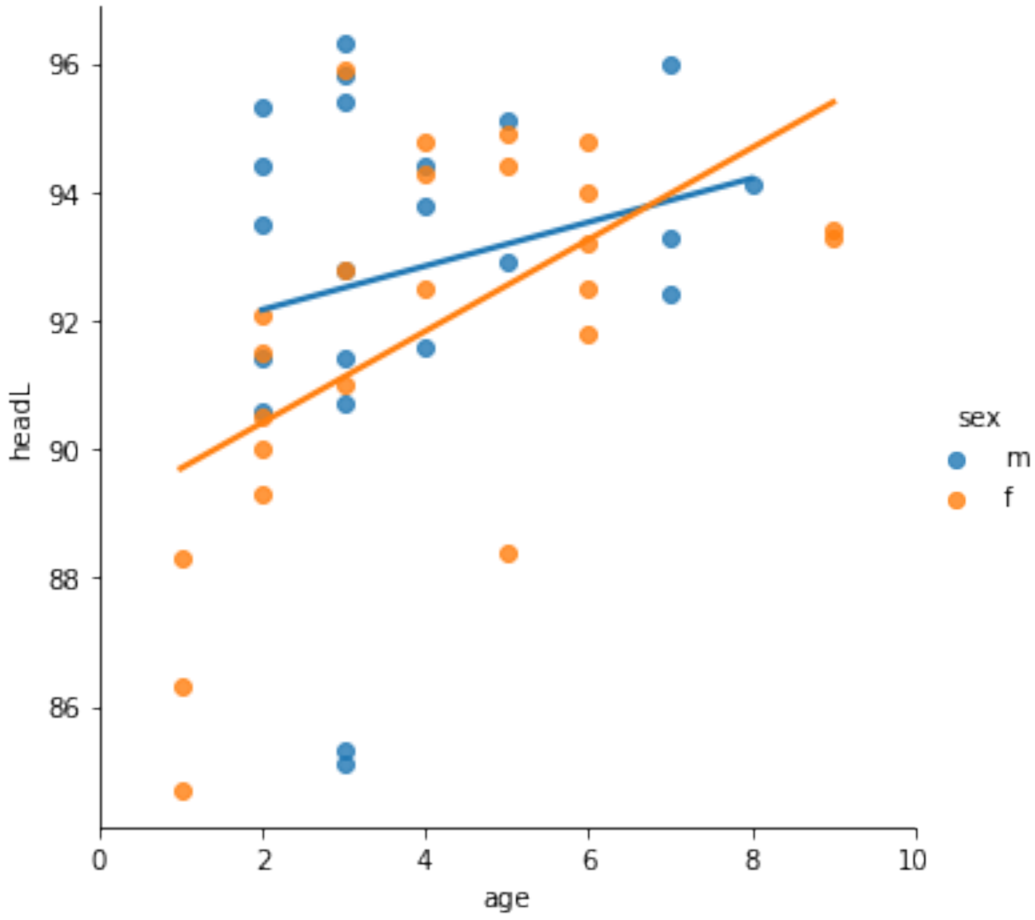
[9]:

```
# Alternative way to plot the fitted line
sns.lmplot(x = "age", y = "headL", data = possum, ci = None)
plt.xlim(0,10)
plt.show()
```



[10]:

```
# Plotting two fitted lines, one for female and another for male possums
sns.lmplot(x = "age", y = "headL", data = possum, hue = "sex", ci = None);
plt.xlim(0,10)
plt.show()
```



1.2 Effect of an Influential Point

```
[11]: # Let's look at the last 5 rows of the original dataset!
      # The original dataset has 46 rows and 6 columns.
      possum.tail()
```

```
[11]:    sex  age  headL  skullW  totalL  tailL
      41   m    3   85.3    54.1    77.0   32.0
      42   f    2   90.0    55.5    81.0   32.0
      43   m    3   85.1    51.5    76.0   35.5
      44   m    3   90.7    55.9    81.0   34.0
      45   m    2   91.4    54.4    84.0   35.0
```

pd.DataFrame.copy: https://pandas.pydata.org/docs/reference/api/pandas.DataFrame.copy.html

```
[12]: # Now we would like to add an influential point and see how this affects the␣
       ↪regression line.
```

```
# We decide to add a point that behaves like an outlier to the bottom of the␣
 ↪dataframe.
# Let's add a point representing "age" = 9 and "headL" = 86.
# We call the new dataframe "possum_modified".
possum_modified = possum.copy()
possum_modified.loc[46, 'age'] = 9
possum_modified.loc[46, 'headL'] = 86
```

[13]:

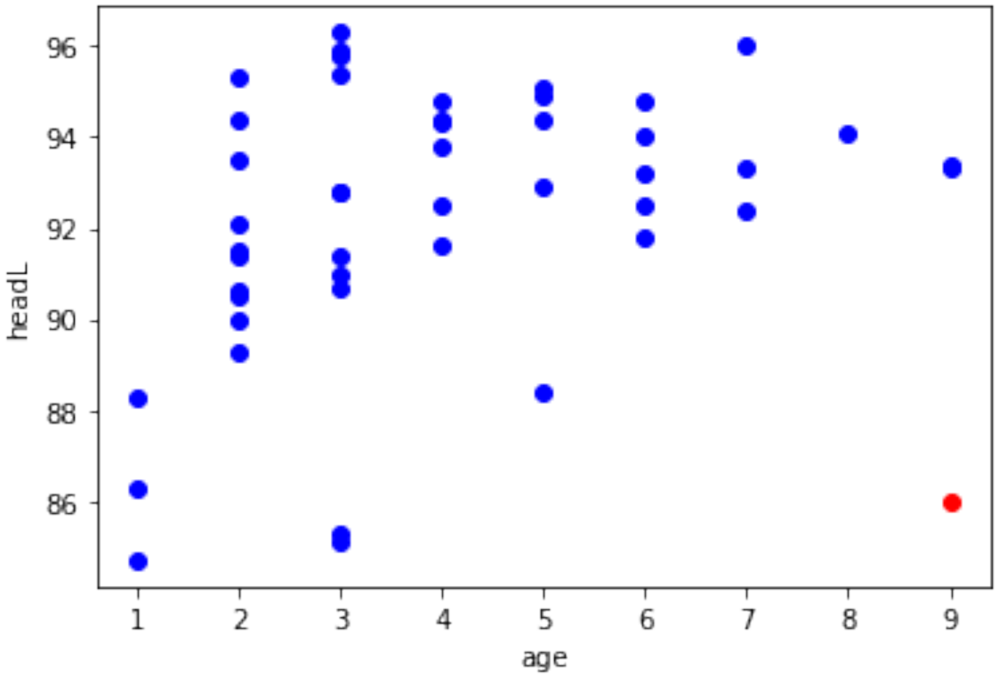
```
# Now let's look at the last 5 rows of the modified dataframe!
possum_modified.tail()
```

[13]:

```
    sex  age  headL  skullW  totalL  tailL
42    f  2.0   90.0    55.5    81.0   32.0
43    m  3.0   85.1    51.5    76.0   35.5
44    m  3.0   90.7    55.9    81.0   34.0
45    m  2.0   91.4    54.4    84.0   35.0
46  NaN  9.0   86.0     NaN     NaN    NaN
```

[14]:

```
# The new point that is added to the dataframe is identified in red in the␣
 ↪scatterplot below.
plt.scatter(possum_modified.loc[0:45, 'age'], possum_modified.loc[0:45,␣
 ↪'headL'], color = 'blue')
plt.scatter(possum_modified.loc[46, 'age'], possum_modified.loc[46, 'headL'],␣
 ↪color = 'red')
plt.xlabel("age")
plt.ylabel("headL")
plt.show()
```



[15]:
```
# Building a new model using the modified dataframe
model_modified = stats.linregress(x = possum_modified['age'], y =␣
 ↪possum_modified['headL'])
```

[16]:
```
# Finding the slope of the regression line
model_modified.slope
```

[16]:
```
0.3585469261900172
```

[17]:
```
# Finding the intercept of the regression line
model_modified.intercept
```

[17]:
```
90.71952206590865
```

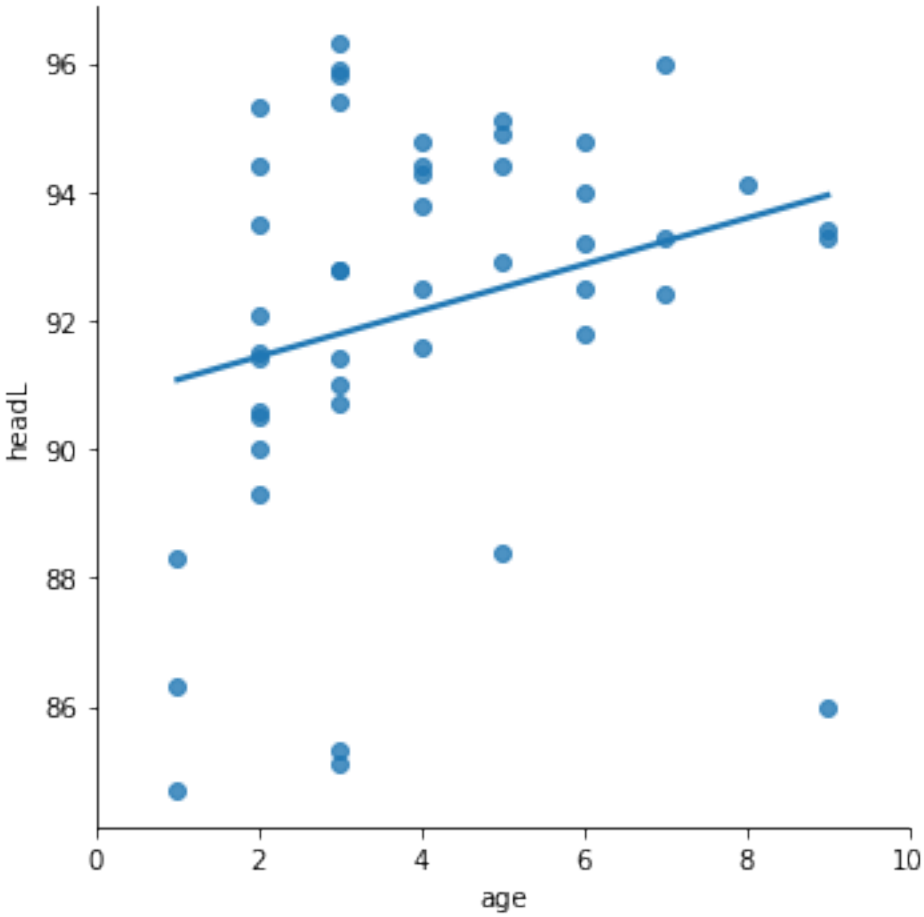
[18]:
```
# Finding the correlation coefficient (R)
model_modified.rvalue
```

[18]:
```
0.2584020565559145
```

[19]:
```
# Calculating the R-squared
(model_modified.rvalue ** 2)
```

[19]:
```
0.06677162283232604
```

[20]:
```
# Plotting the fitted line
sns.lmplot(x = "age", y = "headL", data = possum_modified, ci = None)
plt.xlim(0,10)
plt.show()
```


96
94
92
90
88
86
headL
0
2
4
6
8
10
age

[ ]: