Code:

```
# Importing necessary libraries
import pandas as pd
import numpy as np

wcat = pd.read_csv(":\\Users\\CSE-09\Downloads\\wc-at (1).csv")
C
# Exploratory data analysis:
# 1. Measures of central tendency
# 2. Measures of dispersion
# 3. Third moment business decision
# 4. Fourth moment business decision
# 5. Probability distributions of variables
# 6. Graphical representations (Histogram, Box plot, Dot plot, Stem & Leaf plot, Bar plot, etc.)

wcat.describe()

#Graphical Representation
import matplotlib.pyplot as plt # mostly used for visualization purposes

plt.bar(height = wcat.AT, x = np.arange(1, 110, 1))
plt.hist(wcat.AT) #histogram
plt.boxplot(wcat.AT) #boxplot

plt.bar(height = wcat.Waist, x = np.arange(1, 110, 1))
plt.hist(wcat.Waist) #histogram
plt.boxplot(wcat.Waist) #boxplot

# Scatter plot
plt.scatter(x = wcat['Waist'], y = wcat['AT'], color = 'blue')
# correlation
np.corrcoef(wcat.Waist, wcat.AT)

# Covariance
# NumPy does not have a function to calculate the covariance between two variables directly.
# Function for calculating a covariance matrix called cov()
# By default, the cov() function will calculate the unbiased or sample covariance between the pro
vided random variables.
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cov_output = np.cov(wcat.Waist, wcat.AT)[0, 1]
cov_output

# wcat.cov()


# Import library
import statsmodels.formula.api as smf

# Simple Linear Regression
model = smf.ols('AT ~ Waist', data = wcat).fit()
model.summary()

pred1 = model.predict(pd.DataFrame(wcat['Waist']))

# Regression Line
plt.scatter(wcat.Waist, wcat.AT)
plt.plot(wcat.Waist, pred1, "r")
plt.legend(['Predicted line', 'Observed data'])
plt.show()

# Error calculation
res1 = wcat.AT - pred1
res_sqr1 = res1 * res1
mse1 = np.mean(res_sqr1)
rmse1 = np.sqrt(mse1)
rmse1

######### Model building on Transformed Data
# Log Transformation
# x = log(waist); y = at

plt.scatter(x = np.log(wcat['Waist']), y = wcat['AT'], color = 'brown')
np.corrcoef(np.log(wcat.Waist), wcat.AT) #correlation

model2 = smf.ols('AT ~ np.log(Waist)', data = wcat).fit()
model2.summary()

pred2 = model2.predict(pd.DataFrame(wcat['Waist']))
```

```
# Regression Line
plt.scatter(np.log(wcat.Waist), wcat.AT)
plt.plot(np.log(wcat.Waist), pred2, "r")
plt.legend(['Predicted line', 'Observed data'])
plt.show()

# Error calculation
res2 = wcat.AT - pred2
res_sqr2 = res2 * res2
mse2 = np.mean(res_sqr2)
rmse2 = np.sqrt(mse2)
rmse2


#### Exponential transformation
# x = waist; y = log(at)

plt.scatter(x = wcat['Waist'], y = np.log(wcat['AT']), color = 'orange')
np.corrcoef(wcat.Waist, np.log(wcat.AT)) #correlation

model3 = smf.ols('np.log(AT) ~ Waist', data = wcat).fit()
model3.summary()

pred3 = model3.predict(pd.DataFrame(wcat['Waist']))
pred3_at = np.exp(pred3)
pred3_at

# Regression Line
plt.scatter(wcat.Waist, np.log(wcat.AT))
plt.plot(wcat.Waist, pred3, "r")
plt.legend(['Predicted line', 'Observed data'])
plt.show()

# Error calculation
res3 = wcat.AT - pred3_at
res_sqr3 = res3 * res3
mse3 = np.mean(res_sqr3)
rmse3 = np.sqrt(mse3)
rmse3
```

```
#### Polynomial transformation
# x = waist; x^2 = waist*waist; y = log(at)

model4 = smf.ols('np.log(AT) ~ Waist + I(Waist*Waist)', data = wcat).fit()
model4.summary()

pred4 = model4.predict(pd.DataFrame(wcat))
pred4_at = np.exp(pred4)
pred4_at

# Regression line
from sklearn.preprocessing import PolynomialFeatures
poly_reg = PolynomialFeatures(degree = 2)
X = wcat.iloc[:, 0:1].values
X_poly = poly_reg.fit_transform(X)
# y = wcat.iloc[:, 1].values


plt.scatter(wcat.Waist, np.log(wcat.AT))
plt.plot(X, pred4, color = 'red')
plt.legend(['Predicted line', 'Observed data'])
plt.show()


# Error calculation
res4 = wcat.AT - pred4_at
res_sqr4 = res4 * res4
mse4 = np.mean(res_sqr4)
rmse4 = np.sqrt(mse4)
rmse4


# Choose the best model using RMSE
data = {"MODEL":pd.Series(["SLR", "Log model", "Exp model", "Poly model"]), "RMSE":pd.S
eries([rmse1, rmse2, rmse3, rmse4])}
table_rmse = pd.DataFrame(wcat)
table rmse
```

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###################
# The best model

from sklearn.model_selection import train_test_split

train, test = train_test_split(wcat, test_size = 0.2)

finalmodel = smf.ols('np.log(AT) ~ Waist + I(Waist*Waist)', data = train).fit()
finalmodel.summary()

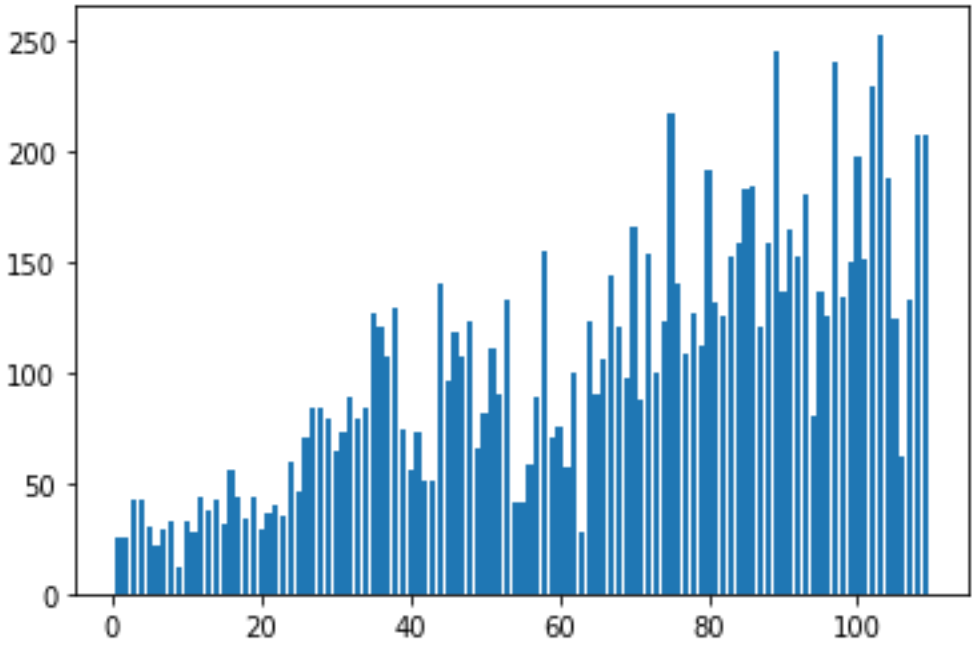
# Predict on test data
test_pred = finalmodel.predict(pd.DataFrame(test))
pred_test_AT = np.exp(test_pred)
pred_test_AT

# Model Evaluation on Test data
test_res = test.AT - pred_test_AT
test_sqrs = test_res * test_res
test_mse = np.mean(test_sqrs)
test_rmse = np.sqrt(test_mse)
test_rmse

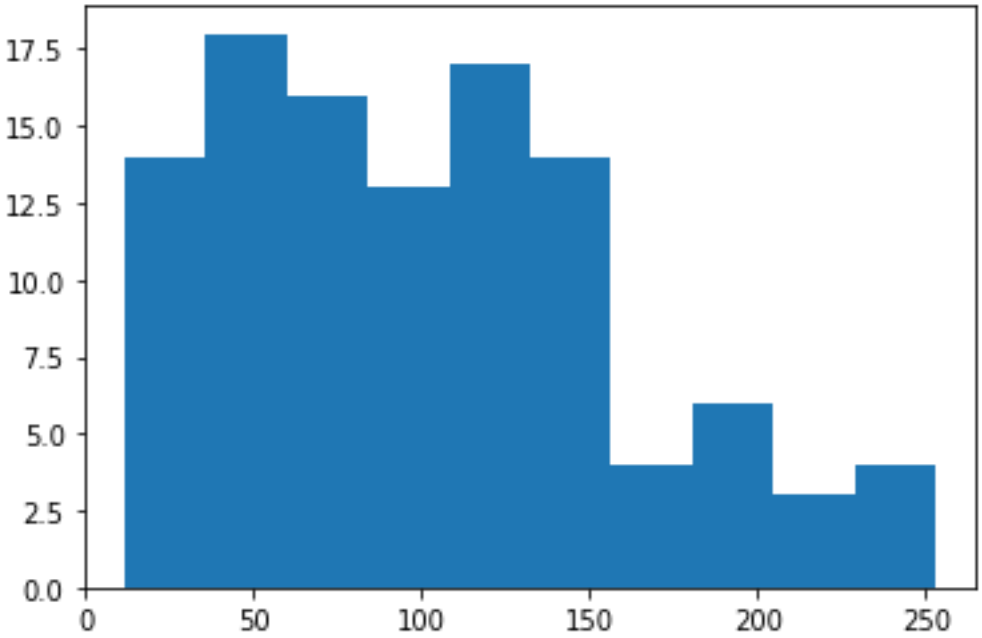

# Prediction on train data
train_pred = finalmodel.predict(pd.DataFrame(train))
pred_train_AT = np.exp(train_pred)
pred_train_AT

# Model Evaluation on train data
train_res = train.AT - pred_train_AT
train_sqrs = train_res * train_res
train_mse = np.mean(train_sqrs)
train_rmse = np.sqrt(train_mse)
train_rmse
```

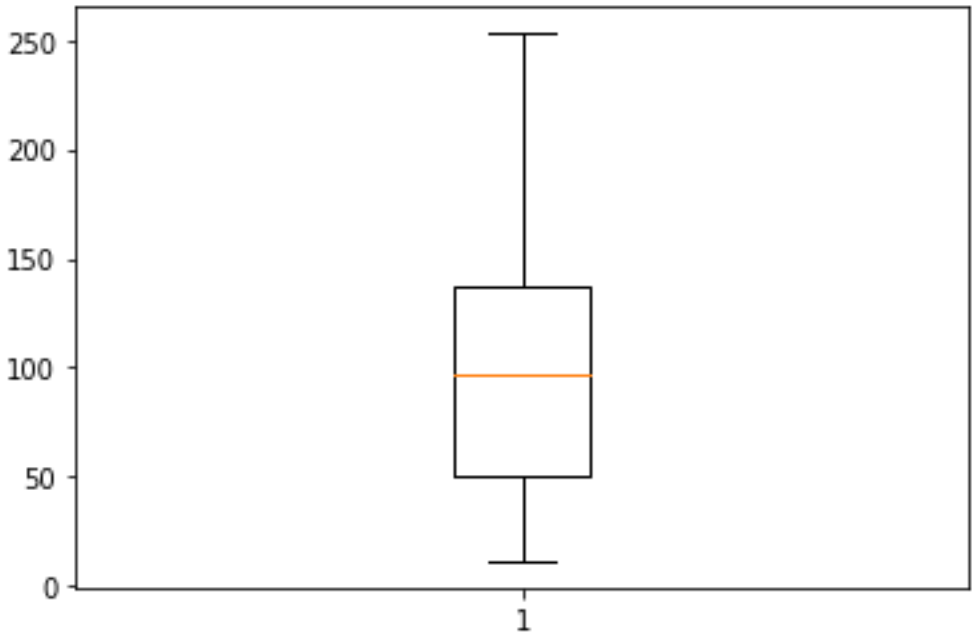
Outputs:



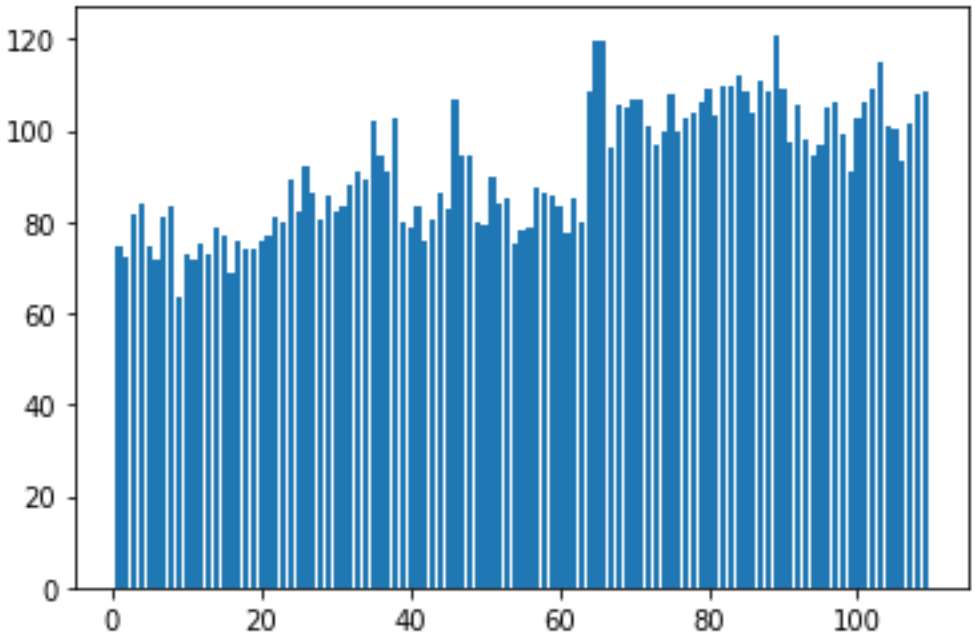
Bar Graph for wcat. AT



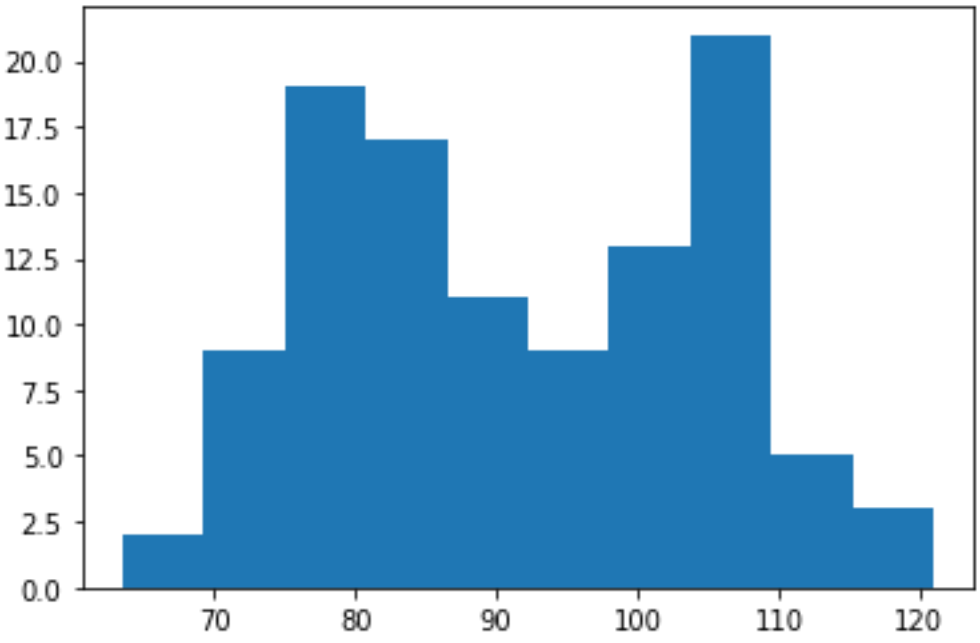
Histogram for wcat. AT



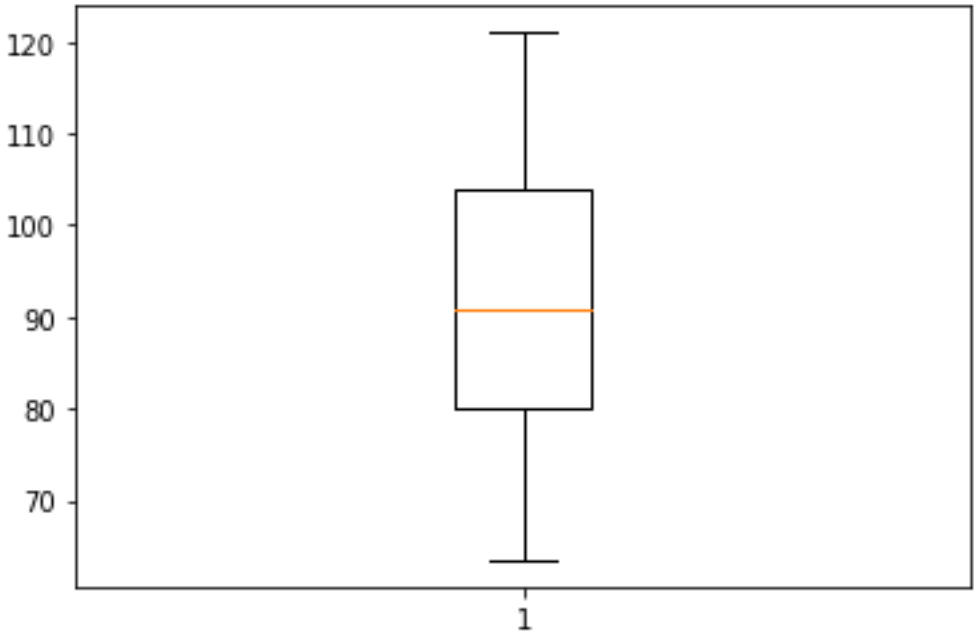
Boxplot for wcat. AT



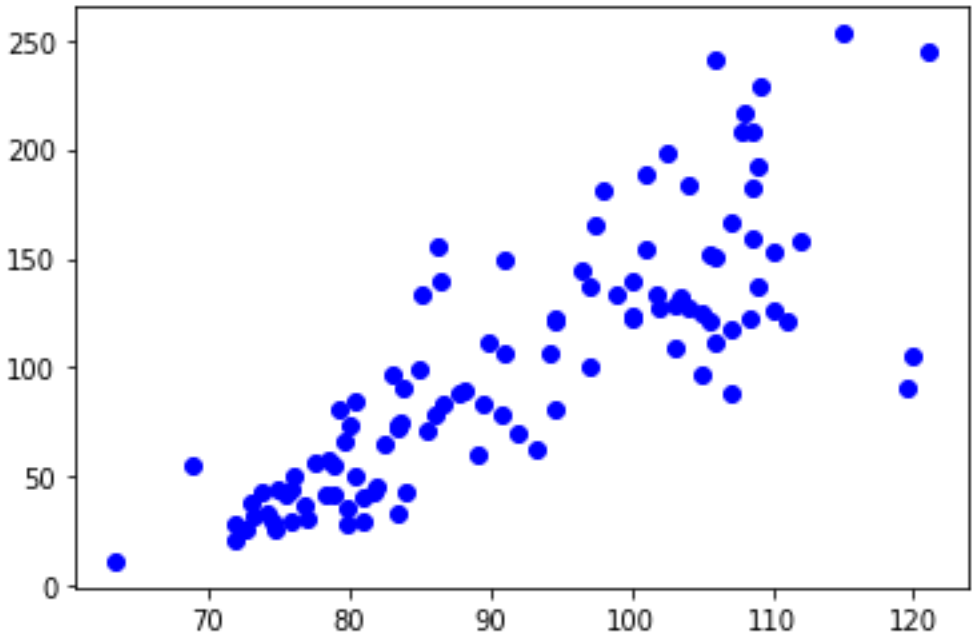
Bar Graph for wcat. Waist



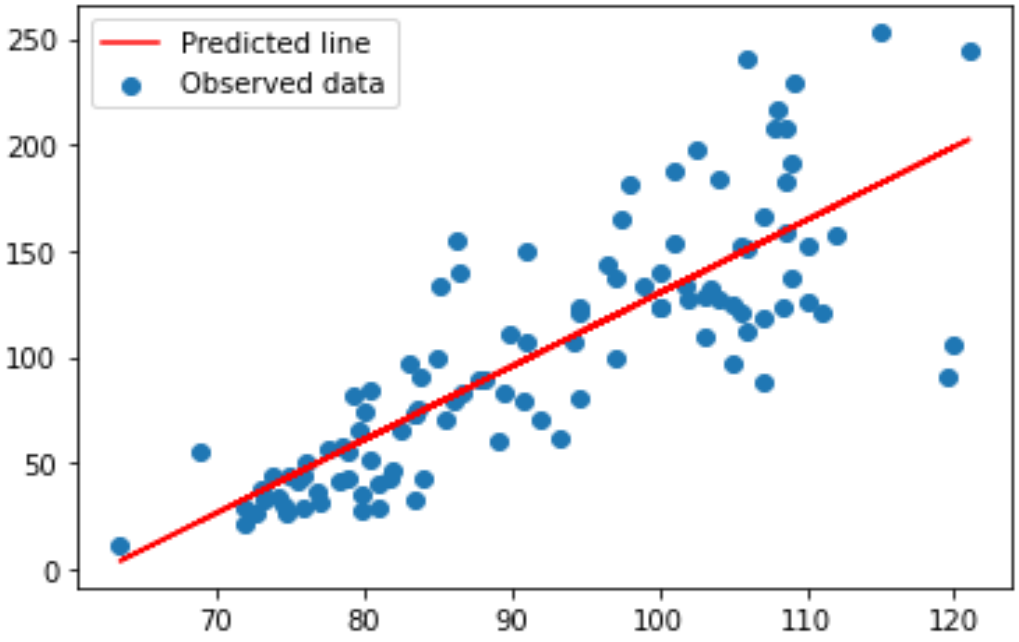
Histogram for wcat. Waist



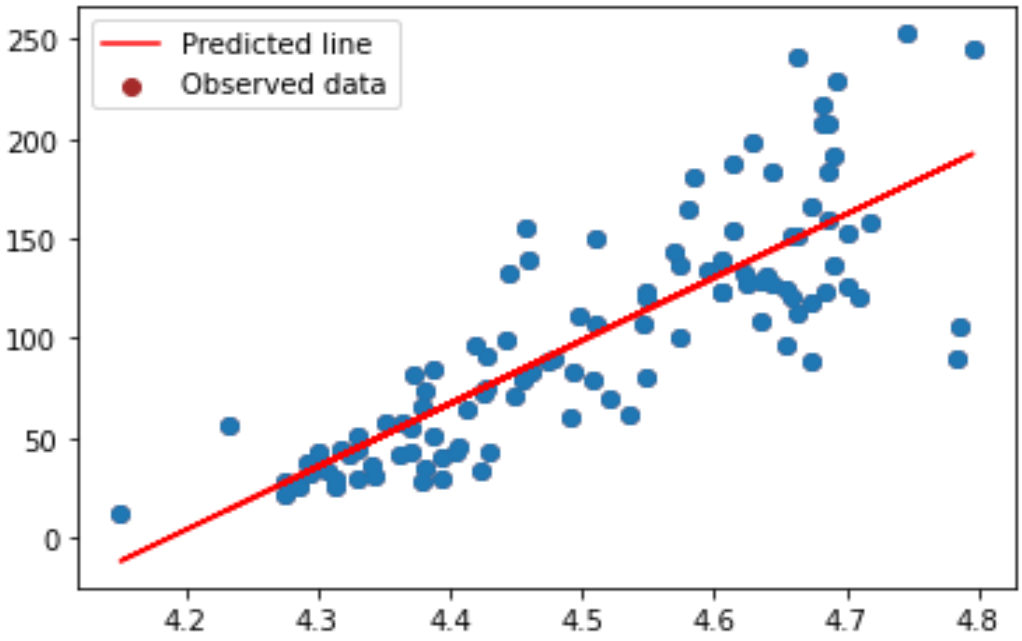
Boxplot for wcat. Waist



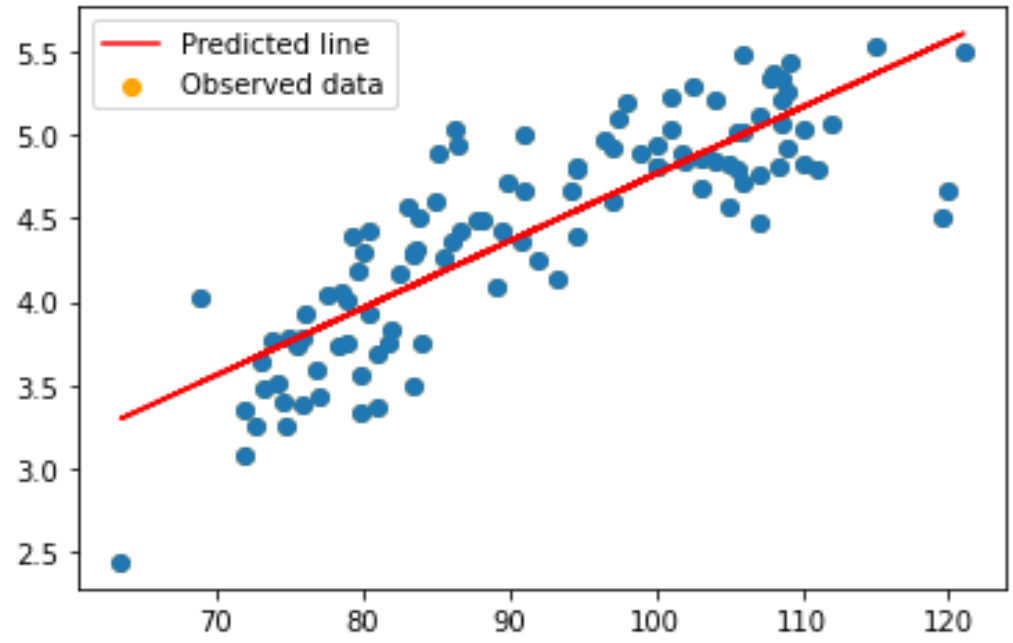
Scatter plot show the split of relation in Waist and AT



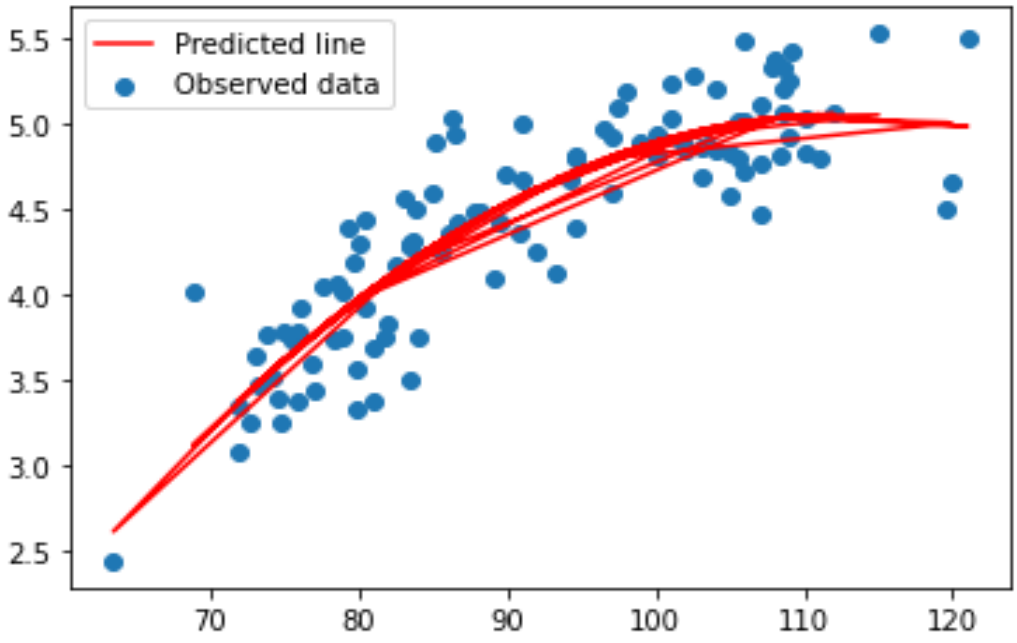
Simple linear Model



Simple linear Model (Log)



Simple linear Model (Exponential)



Simple linear Model (Polynomial)