

Data and Artificial Intelligence

Cyber Shujaa Program

Week 7 Assignment

Regression models

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Introduction

This week's assignment was to develop hands-on experience in building a **Linear Regression model** using Python. I explored a dataset, trained and tested my model, and visualized my results.

The purpose of the assignment was to gain hands-on practice in:

- Exploring a real-world dataset
- Preparing and splitting data for training and testing
- Building a simple linear regression model
- Evaluating the model using key metrics
- Visualizing predictions and regression lines
- Publishing your project as part of your portfolio collection

Tasks Completed

Part 1: simple linear regression

Step 1: exploring the data set given

In this step I imported the homeprices.csv data set as pandas' data frame. To get an overview of the data I ran the `df.head()` command.

Code

```
import pandas as pd

import numpy as np

import matplotlib.pyplot as plt

from sklearn import linear_model

from google.colab import files

uploaded = files.upload()

df = pd.read_csv('homeprices.csv')
```

`df.head()`

Screenshot:

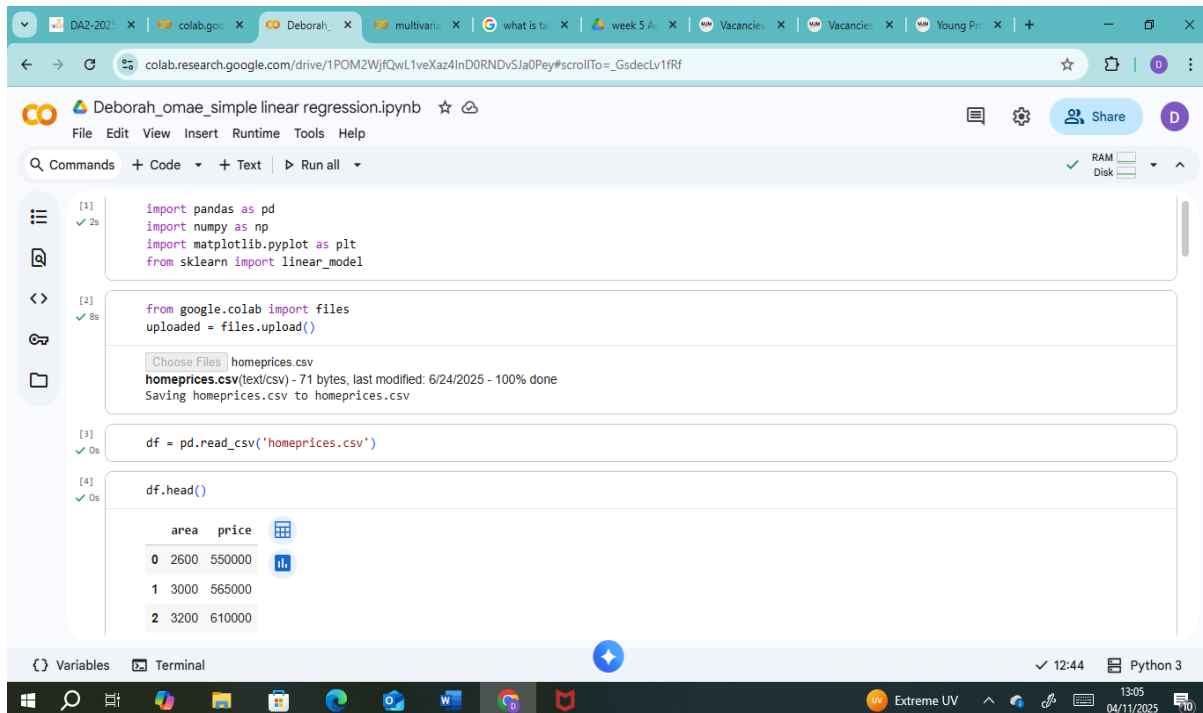


Figure 1: screenshot showing the imported dataset as a pandas data frame

Step 2: visualizing my data

I visualized the distribution of my dataset through a scatter plot.

Code:

`plt.xlabel('area')`

`plt.ylabel('price')`

`plt.scatter(df.area,df.price,color='red',marker='+')`

Screenshot:

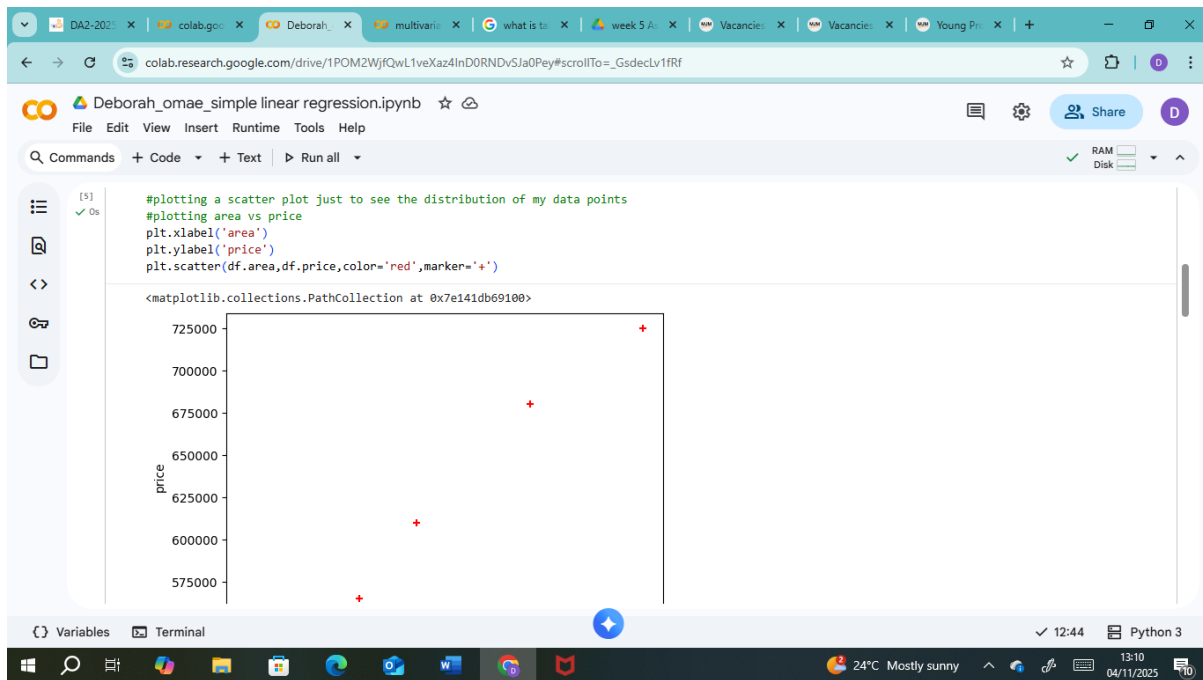


Figure 2: A scatter plot showing the area vs price

Step 3: preparing and splitting the data for training and testing

I used a linear regression model from Scikitlearn library. In order to train my regression model, I had to split my data set into 80% training and 20% testing. This is because we have to see how the model works on unseen data.

Code:

```
from sklearn.model_selection import train_test_split

# drawing the linear regression line after seeing the distribution

reg = linear_model.LinearRegression()

# Split the data into training and testing sets

X_train, X_test, y_train, y_test = train_test_split(df[['area']], df.price, test_size=0.2, random_state=0)

print('X_test', X_test)

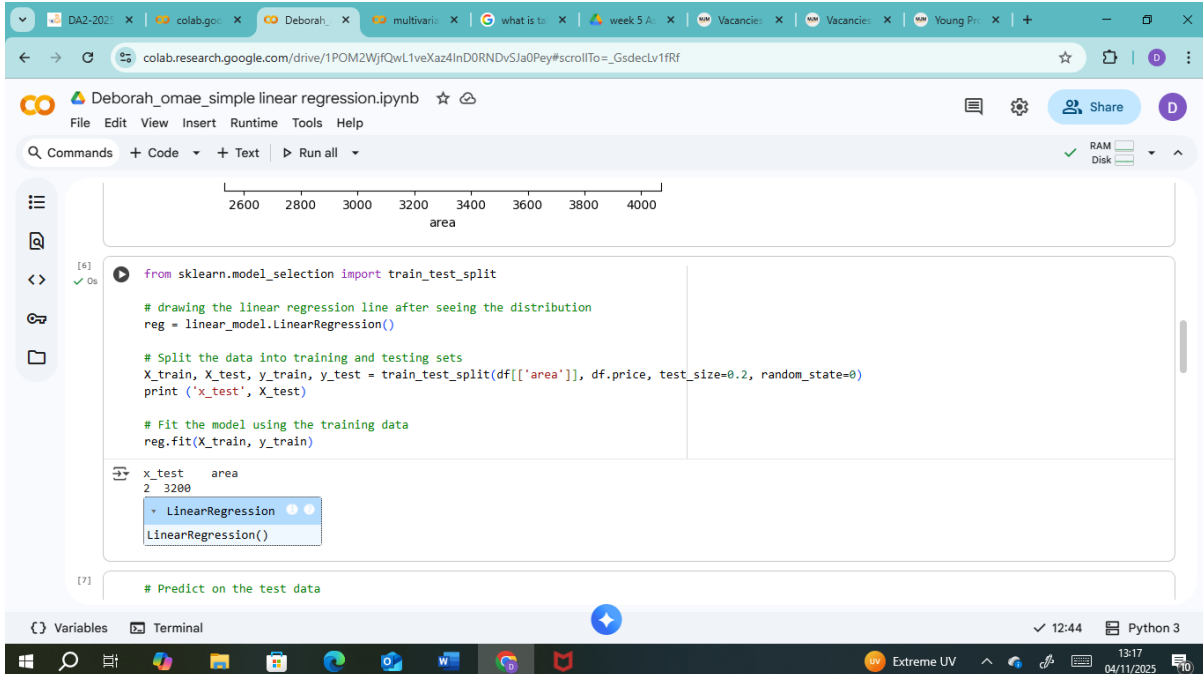
# Fit the model using the training data

reg.fit(X_train, y_train)

y_pred = reg.predict(X_test)

display(y_pred)
```

Screenshot:



```

from sklearn.model_selection import train_test_split

# drawing the linear regression line after seeing the distribution
reg = linear_model.LinearRegression()

# Split the data into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(df[['area']], df.price, test_size=0.2, random_state=0)
print ('X_test', X_test)

# Fit the model using the training data
reg.fit(X_train, y_train)

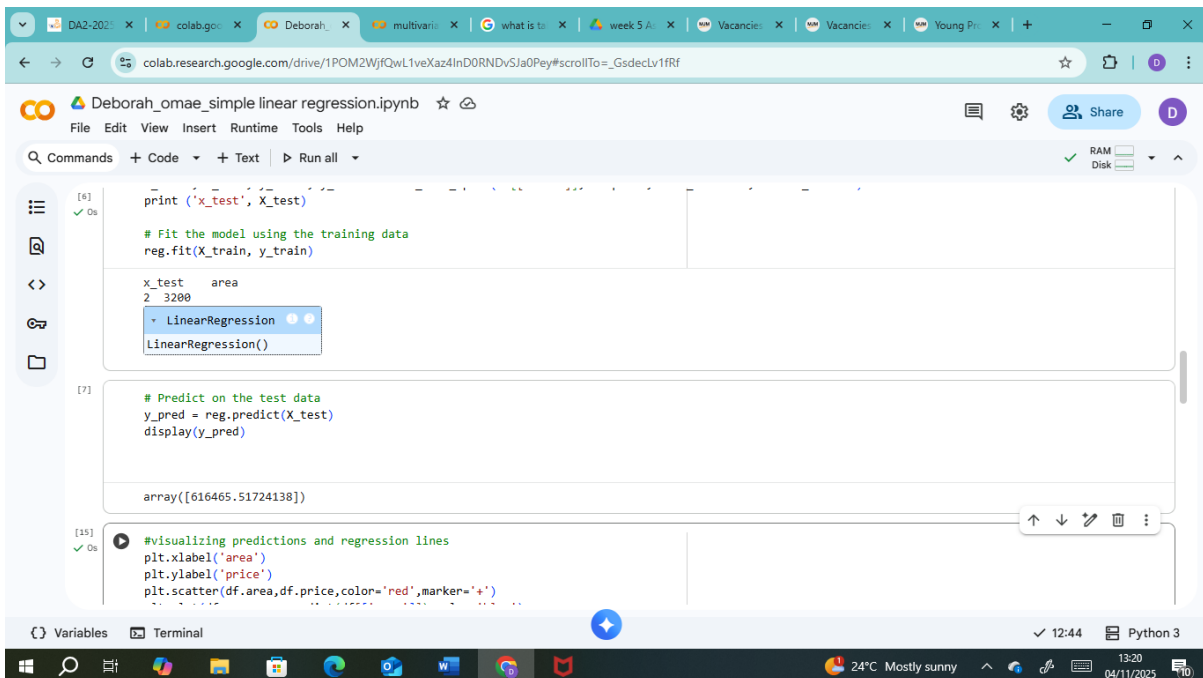
X_test    area
2    3200
  
```

LinearRegression

LinearRegression()

Predict on the test data

Figure 3: screenshot showing the code for splitting the data set. It can be seen that my testing data is 3200



```

print ('X_test', X_test)

# Fit the model using the training data
reg.fit(X_train, y_train)

X_test    area
2    3200
  
```

LinearRegression

LinearRegression()

```

# Predict on the test data
y_pred = reg.predict(X_test)
display(y_pred)

array([616465.51724138])
  
```

#visualizing predictions and regression lines

```

plt.xlabel('area')
plt.ylabel('price')
plt.scatter(df.area, df.price, color='red', marker='*')
  
```

Figure 4: screenshot showing the predicted price for the area Of 3200

Step 4: visualizing predictions and regression lines

I visualized the predicted prices against the original prices

Code

#visualizing predictions and regression lines

```
plt.xlabel('area')
```

```
plt.ylabel('price')
```

```
plt.scatter(df.area,df.price,color='red',marker='+')
```

```
plt.plot(df.area,reg.predict(df[['area']]),color='blue')
```

Plot the predicted prices against the original areas

```
plt.scatter(df.area, reg.predict(df[['area']]), color='green', marker='x', label='Predicted Price')
```

```
plt.legend()
```

Screenshot:

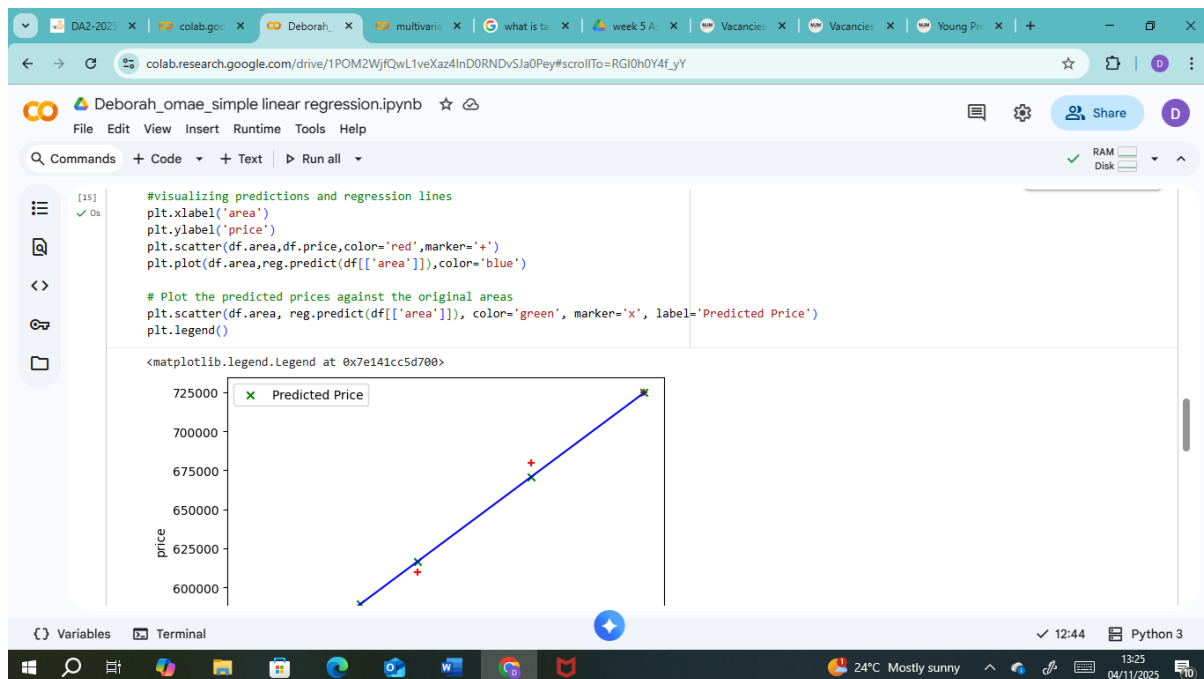


Figure 5: screenshot showing the visualized predictions

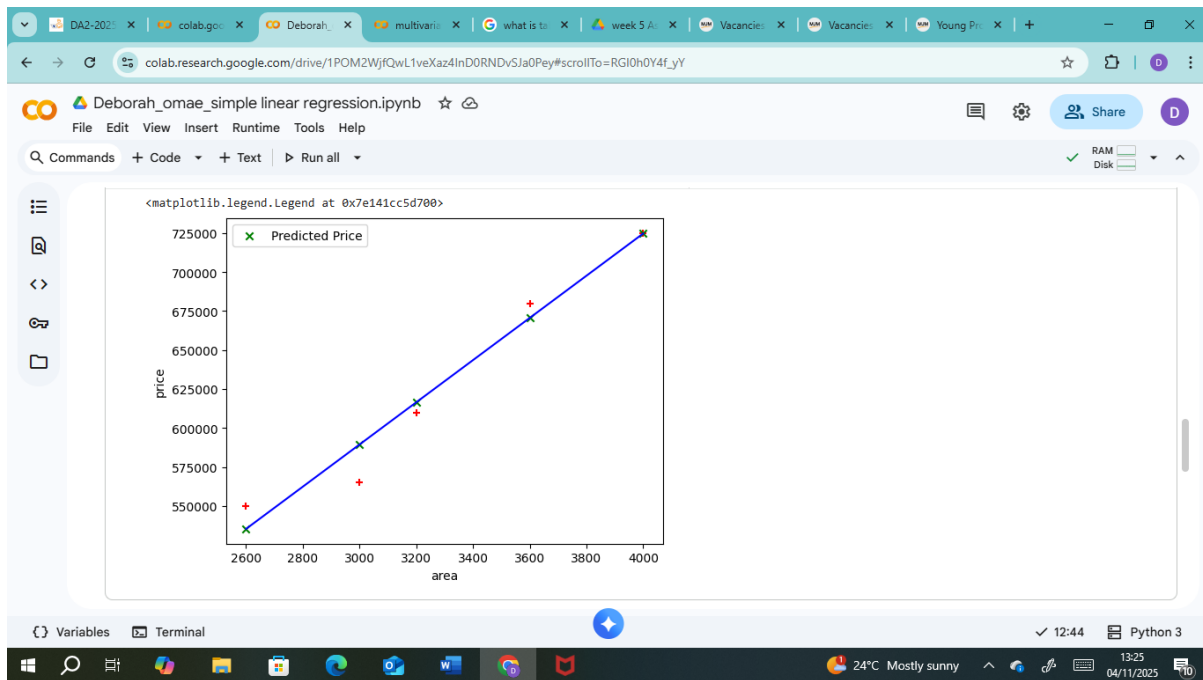


Figure 6: graph showing predicted and actual prices

Step 5: evaluating my model using key metrics

In this step I evaluated my model using regression metrics such as mean absolute error, mean squared error, root mean squared error, and R^2

MAE is the **average of the absolute differences** between actual and predicted values. It measures how far, on average, the predictions are from the real values.

MSE is the average of squared differences between actual and predicted values. By squaring the errors, it gives more weight to larger mistakes, making it useful when large errors are especially undesirable.

RMSE is the square root of the MSE, converting the result back to the same unit as the target variable. It represents the standard deviation of prediction errors. In other words, how much the predictions typically deviate from the actual values.

R^2 (coefficient of determination) measures the **proportion of the variance in the dependent variable** that is explained by the independent variables in the model. It compares how well your model performs against a simple baseline model that always predicts the mean.

Code

#evaluating this model using the regression metrics; MSE, RMSE, AME, R2

```
from sklearn.metrics import mean_squared_error, mean_absolute_error, root_mean_squared_error,
r2_score

mae = mean_absolute_error(y_test, y_pred)

mse = mean_squared_error(y_test, y_pred)

rmse = root_mean_squared_error(y_test, y_pred)

r2 = r2_score(y_test, y_pred)

print('Mean Absolute Error:', mae)

print('Mean Squared Error:', mse)

print('Root Mean Squared Error:', rmse)

print('R-squared:', r2)
```

Screenshot:

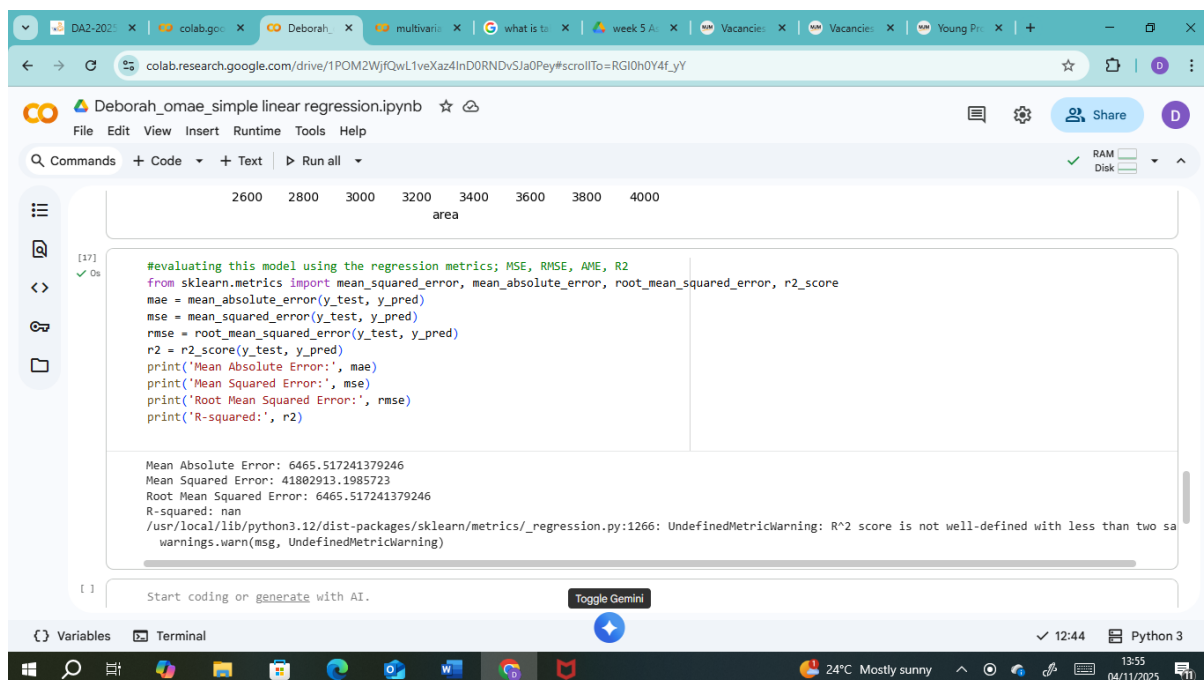


Figure 7: screenshot of model evaluation

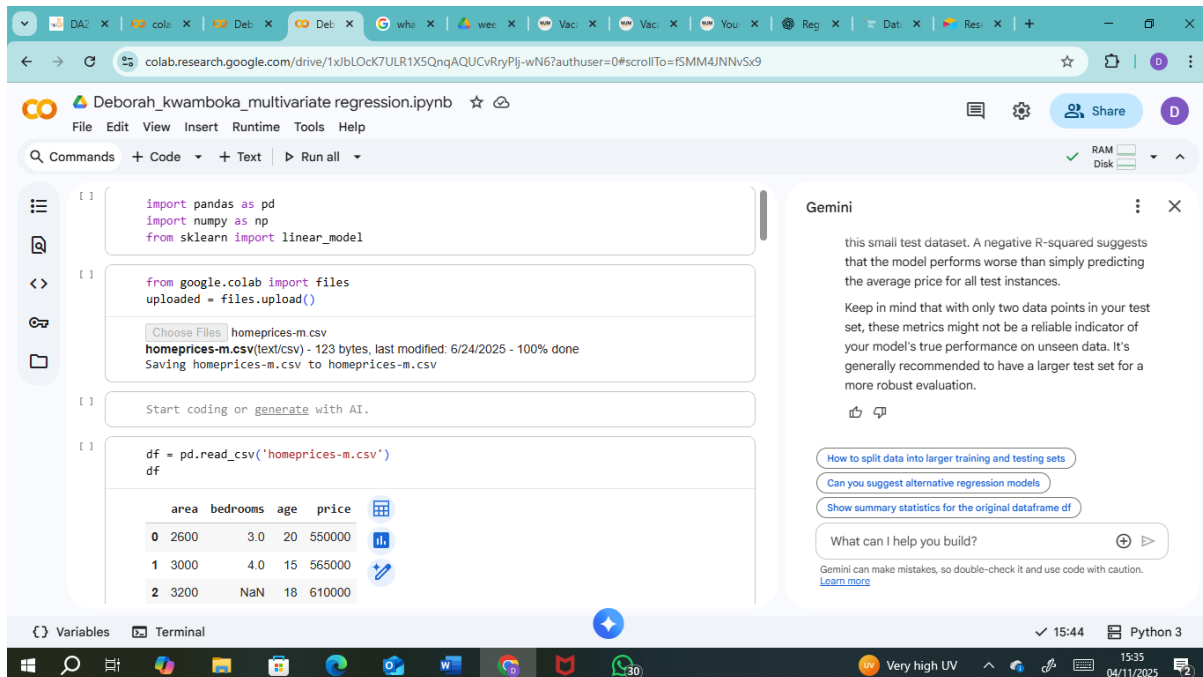
Evaluation

The model has a mean absolute error and root mean square error of approximately 6465. This shows the error margin between our predicted value and actual value. Therefore, the predictions are reliable.

Part 2: linear regression with multiple variables

Step 1: exploring the dataset

I imported the homeprices-m .csv into a pandas' data frame and got an overview of the data.



The screenshot shows a Google Colab notebook titled "Deborah_kwamboka_multivariate regression.ipynb". The code cell contains the following Python code:

```
import pandas as pd
import numpy as np
from sklearn import linear_model

from google.colab import files
uploaded = files.upload()

df = pd.read_csv('homeprices-m.csv')
```

The output of the code cell shows a preview of the DataFrame:

	area	bedrooms	age	price
0	2600	3.0	20	550000
1	3000	4.0	15	565000
2	3200	NaN	18	610000

Figure 8: screenshot showing the dataset imported as pandas DataFrame

Step 2: data preparation and cleaning

My data set had one missing value in the bedroom's column. I imputed the missing value using the median of the bedroom's column.

The code:

```
df.bedrooms = df.bedrooms.fillna(df.bedrooms.median())
```

df

screenshot:

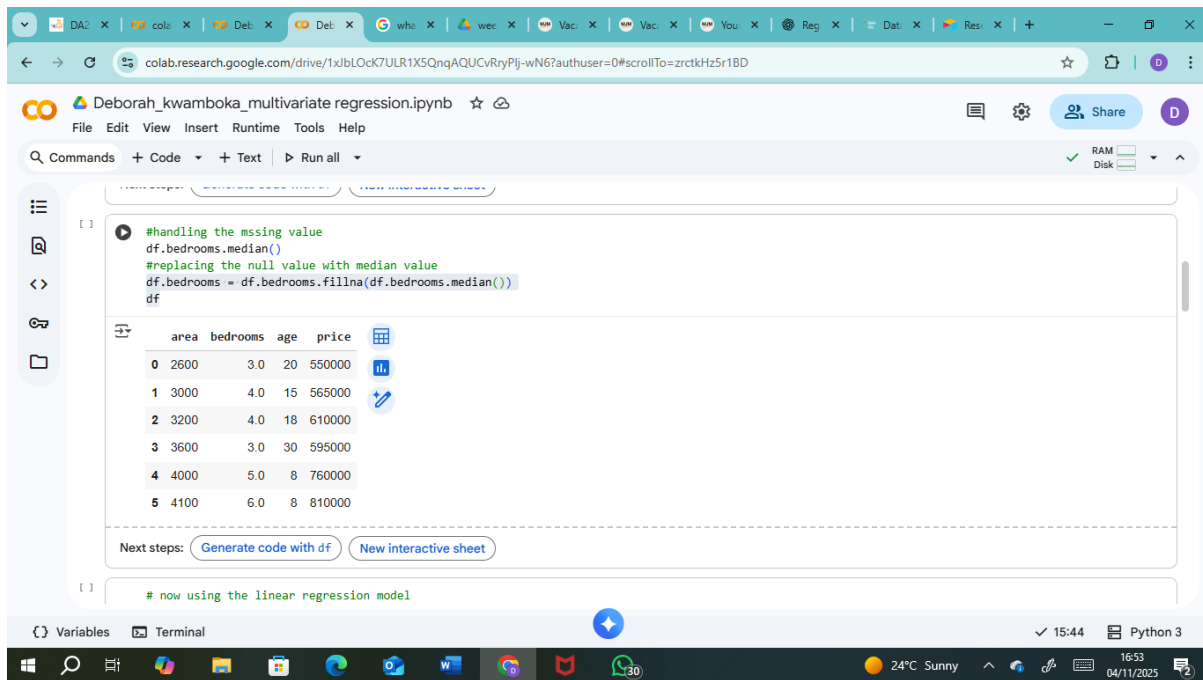


Figure 9: screenshot showing the handled missing value

step 3: splitting data into training and testing and fitting the regression model

In this step I had to split my data homeprices-m into training and testing data.

#80% training and 20% testing. I manually selected the data points for training and testing.

Code:

```
from sklearn.model_selection import train_test_split
```

```
from sklearn.metrics import mean_absolute_error, mean_squared_error, root_mean_squared_error,
r2_score
```

```
p = df[['area', 'bedrooms', 'age']]
```

```
t = df['price']
```

```
print(p)
```

```
print("")
```

```
print(t)
```

```
# Manually splitting the data with index 1 and 2 for testing
```

```
p_test = p.iloc[[1, 2]]
```

```
t_test = t.iloc[[1, 2]]

p_train = p.drop([1, 2])

t_train = t.drop([1, 2])


print(p_train)

print("")

print(p_test)

print("")

print(t_train)

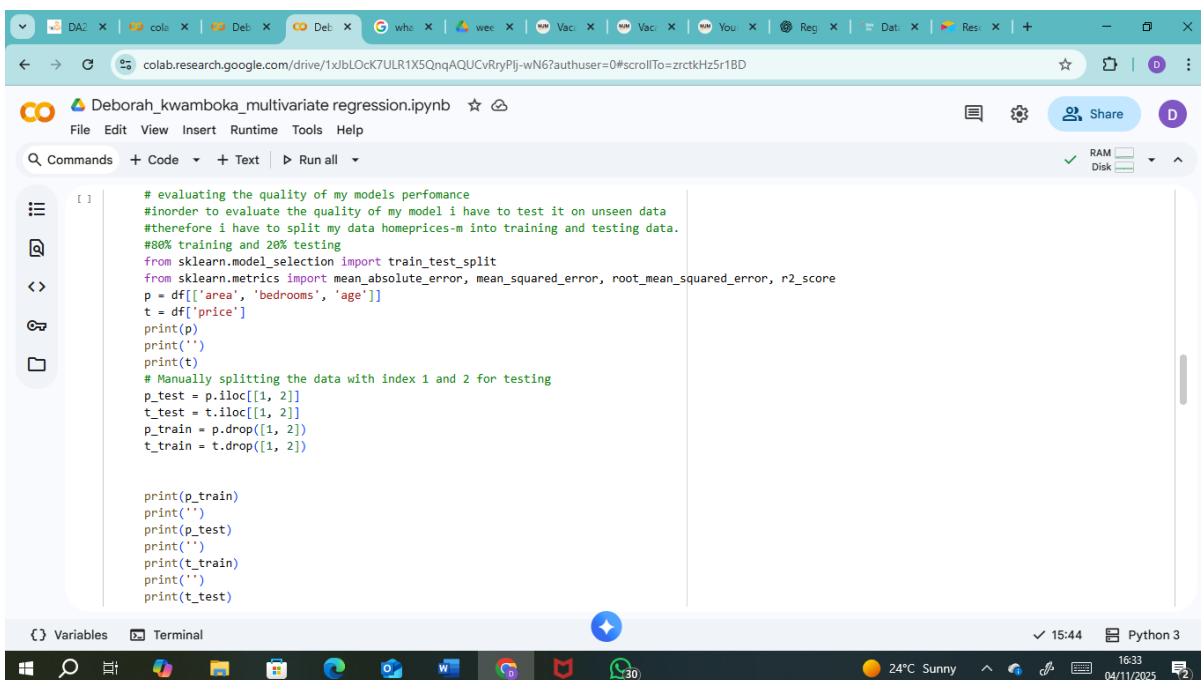
print("")

print(t_test)

model = linear_model.LinearRegression()

model.fit(p_train, t_train)
```

screenshot:

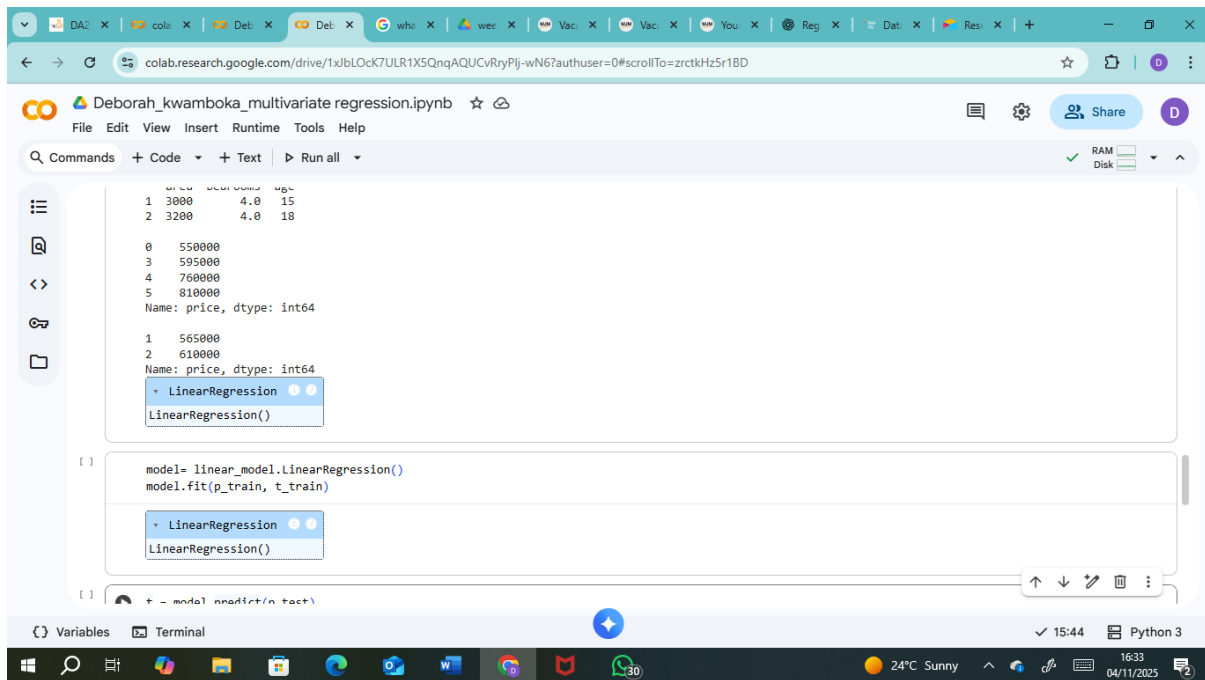


The screenshot shows a Google Colab notebook titled "Deborah_kwamboka_multivariate regression.ipynb". The code in the notebook is as follows:

```
# evaluating the quality of my models performance
#inorder to evaluate the quality of my model i have to test it on unseen data
#therefore i have to split my data homeprices-m into training and testing data.
#80% training and 20% testing
from sklearn.model_selection import train_test_split
from sklearn.metrics import mean_absolute_error, mean_squared_error, root_mean_squared_error, r2_score
p = df[['area', 'bedrooms', 'age']]
t = df['price']
print(p)
print("")
print(t)
# Manually splitting the data with index 1 and 2 for testing
p_test = p.iloc[[1, 2]]
t_test = t.iloc[[1, 2]]
p_train = p.drop([1, 2])
t_train = t.drop([1, 2])

print(p_train)
print("")
print(p_test)
print("")
print(t_train)
print("")
print(t_test)
```

The notebook interface includes a menu bar (File, Edit, View, Insert, Runtime, Tools, Help), a toolbar with icons for file operations, and a status bar at the bottom showing "15:44 Python 3". The system taskbar at the very bottom shows the date "04/11/2025" and weather "24°C Sunny".



Step 4: evaluating the model

In this step I evaluated our regression model through regression metrics such as mean square error and mean absolute error.

Code:

```
# getting the regression metrics
```

```
mae = mean_absolute_error(t_test, t)
```

```
mse = mean_squared_error(t_test, t)
```

```
rmse = root_mean_squared_error(t_test, t)
```

```
r2 = r2_score(t_test, t)
```

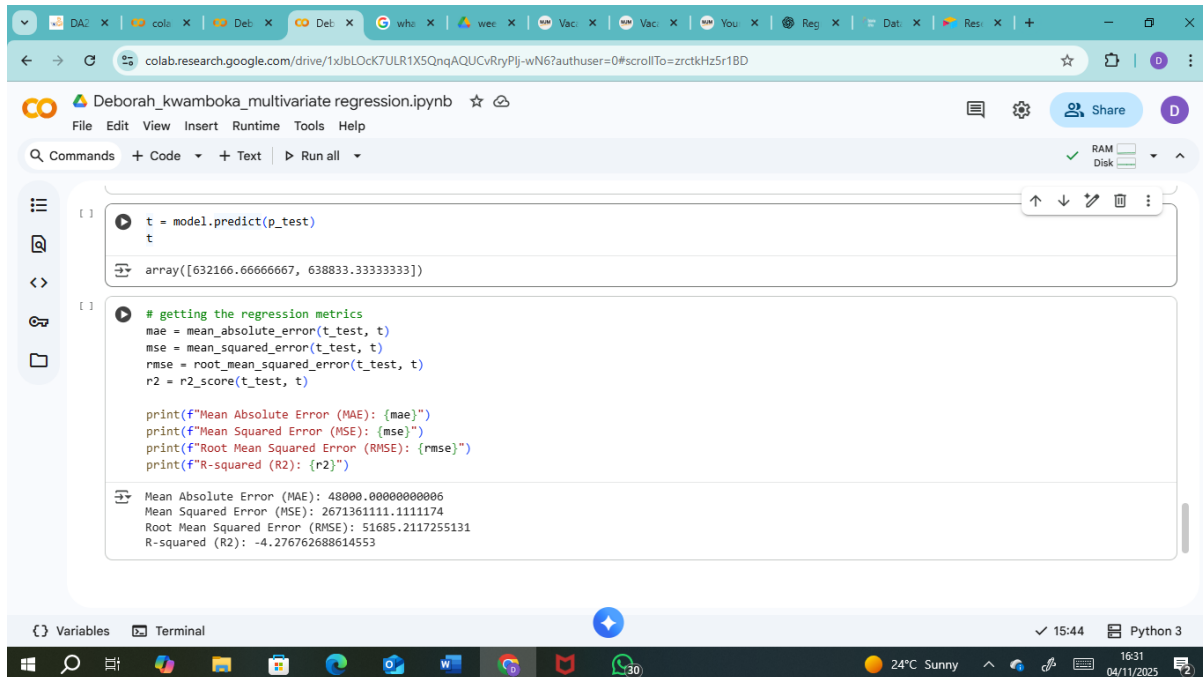
```
print(f"Mean Absolute Error (MAE): {mae}")
```

```
print(f"Mean Squared Error (MSE): {mse}")
```

```
print(f"Root Mean Squared Error (RMSE): {rmse}")
```

```
print(f"R-squared (R2): {r2}")
```

screenshot:



The screenshot shows a Google Colab notebook titled "Deborah_kwamboka_multivariate regression.ipynb". The notebook contains two code cells. The first cell runs `t = model.predict(p_test)` and displays the output as an array: `array([632166.66666667, 638833.33333333])`. The second cell calculates regression metrics and prints them:

```
# getting the regression metrics
mae = mean_absolute_error(t_test, t)
mse = mean_squared_error(t_test, t)
rmse = root_mean_squared_error(t_test, t)
r2 = r2_score(t_test, t)

print(f"Mean Absolute Error (MAE): {mae}")
print(f"Mean Squared Error (MSE): {mse}")
print(f"Root Mean Squared Error (RMSE): {rmse}")
print(f"R-squared (R2): {r2}")
```

The output of the second cell shows the following values:

```
Mean Absolute Error (MAE): 48000.000000000006
Mean Squared Error (MSE): 2671361111.1111174
Root Mean Squared Error (RMSE): 51685.2117255131
R-squared (R2): -4.276762688614553
```

Figure 10: screenshot showing the evaluation of the model

Evaluation

The data set has a mean absolute error of approximately 48000 and R^2 is -4. This shows that our model is making poor predictions. Perhaps it needs training with a larger dataset.

Link to code

Link to Code:

Link 1(for simple linear regression):

<https://colab.research.google.com/drive/1POM2WjfQwL1veXaz4InDORNDvSJa0Pey?usp=sharing>

Link 2(for linear regression with multiple variables):

<https://colab.research.google.com/drive/1xJbLOcK7ULR1X5QnqAQUcVrRyPlj-wN6?usp=sharing>

Conclusion

In this task, a linear regression model was developed to predict house prices based on key features such as area (in square feet), number of bedrooms, and age of the house. The model was trained and evaluated using standard regression performance metrics including Mean Absolute Error (MAE), Mean Squared Error (MSE), Root Mean Squared Error (RMSE), and the R^2 score. I can confidently say that a linear regression model is a good fit to make predictions and is more reliable with a larger dataset.