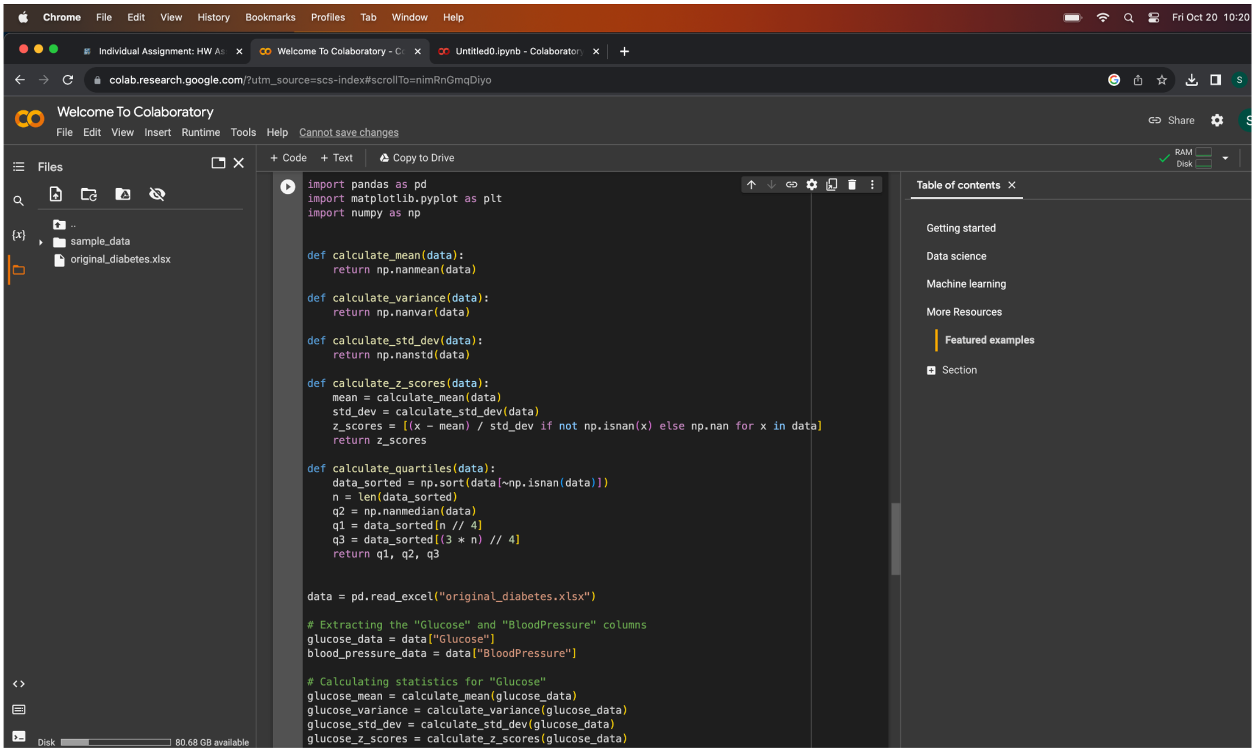
Question 1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sample_data
original_diabetes.xlsx
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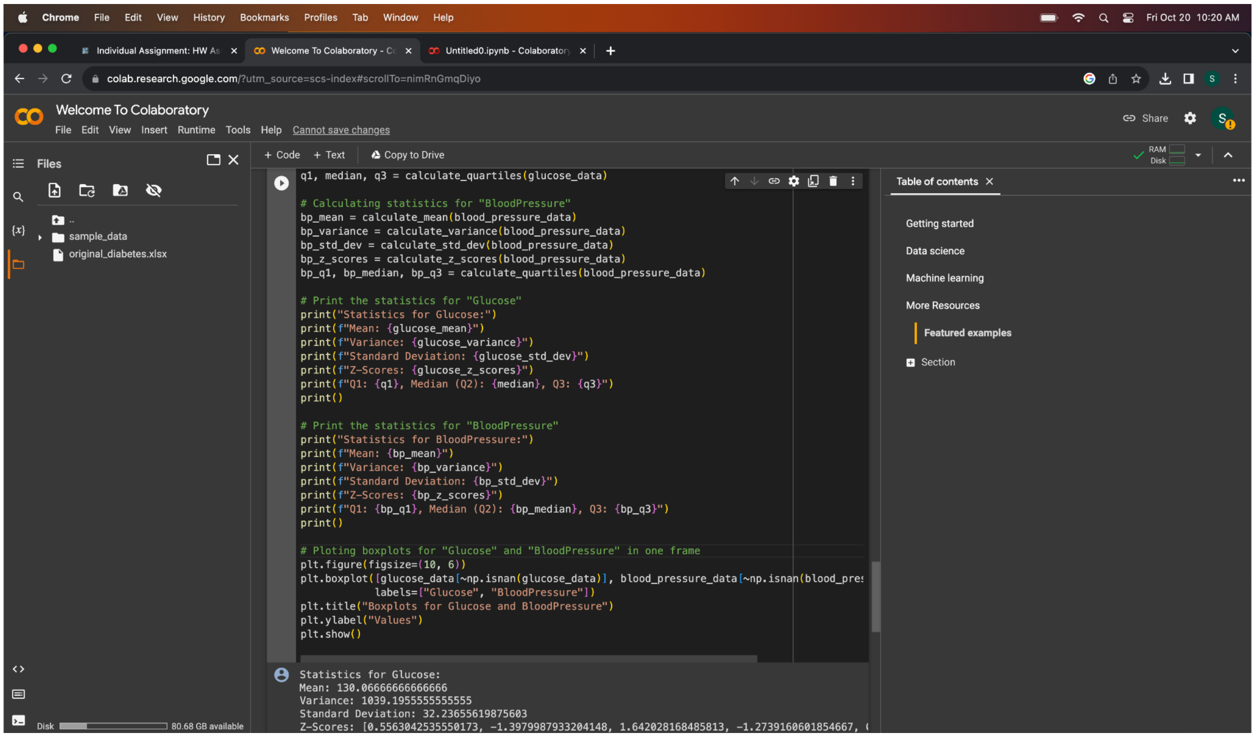
```
import pandas as pd
import matplotlib.pyplot as plt
import numpy as np


def calculate_mean(data):
    return np.nanmean(data)

def calculate_variance(data):
    return np.nanvar(data)

def calculate_std_dev(data):
    return np.nanstd(data)

def calculate_z_scores(data):
    mean = calculate_mean(data)
    std_dev = calculate_std_dev(data)
    z_scores = [(x - mean) / std_dev if not np.isnan(x) else np.nan for x in data]
    return z_scores

def calculate_quartiles(data):
    data_sorted = np.sort(data[~np.isnan(data)])
    n = len(data_sorted)
    q2 = np.nanmedian(data)
    q1 = data_sorted[n // 4]
    q3 = data_sorted[(3 * n) // 4]
    return q1, q2, q3


data = pd.read_excel("original_diabetes.xlsx")

# Extracting the "Glucose" and "BloodPressure" columns
glucose_data = data["Glucose"]
blood_pressure_data = data["BloodPressure"]

# Calculating statistics for "Glucose"
glucose_mean = calculate_mean(glucose_data)
glucose_variance = calculate_variance(glucose_data)
glucose_std_dev = calculate_std_dev(glucose_data)
glucose_z_scores = calculate_z_scores(glucose_data)
```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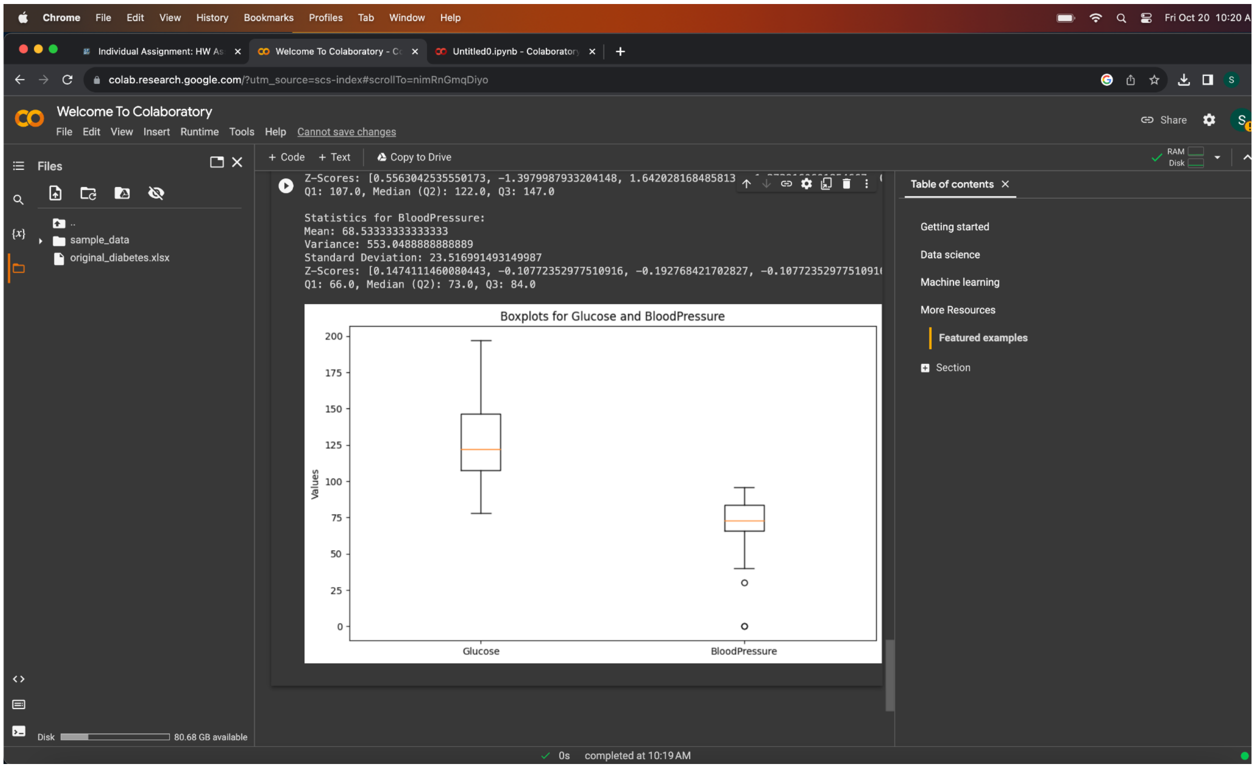
```
q1, median, q3 = calculate_quartiles(glucose_data)

# Calculating statistics for "BloodPressure"
bp_mean = calculate_mean(blood_pressure_data)
bp_variance = calculate_variance(blood_pressure_data)
bp_std_dev = calculate_std_dev(blood_pressure_data)
bp_z_scores = calculate_z_scores(blood_pressure_data)
bp_q1, bp_median, bp_q3 = calculate_quartiles(blood_pressure_data)

# Print the statistics for "Glucose"
print("Statistics for Glucose:")
print(f"Mean: {glucose_mean}")
print(f"Variance: {glucose_variance}")
print(f"Standard Deviation: {glucose_std_dev}")
print(f"Z-Scores: {glucose_z_scores}")
print(f"Q1: {q1}, Median (Q2): {median}, Q3: {q3}")
print()

# Print the statistics for "BloodPressure"
print("Statistics for BloodPressure:")
print(f"Mean: {bp_mean}")
print(f"Variance: {bp_variance}")
print(f"Standard Deviation: {bp_std_dev}")
print(f"Z-Scores: {bp_z_scores}")
print(f"Q1: {bp_q1}, Median (Q2): {bp_median}, Q3: {bp_q3}")
print()

# Ploting boxplots for "Glucose" and "BloodPressure" in one frame
plt.figure(figsize=(10, 6))
plt.boxplot([glucose_data[~np.isnan(glucose_data)], blood_pressure_data[~np.isnan(blood_pres
            labels=["Glucose", "BloodPressure"])
plt.title("Boxplots for Glucose and BloodPressure")
plt.ylabel("Values")
plt.show()
```

```
Statistics for Glucose:
Mean: 130.06666666666666
Variance: 1039.1955555555555
Standard Deviation: 32.23655619875603
Z-Scores: [0.5563042535550173, -1.3979987933204148, 1.642028168485813, -1.2739160601854667, (
```



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Boxplots for Glucose and BloodPressure
Values
200
175
150
125
100
75
50
25
0
Glucose
BloodPressure
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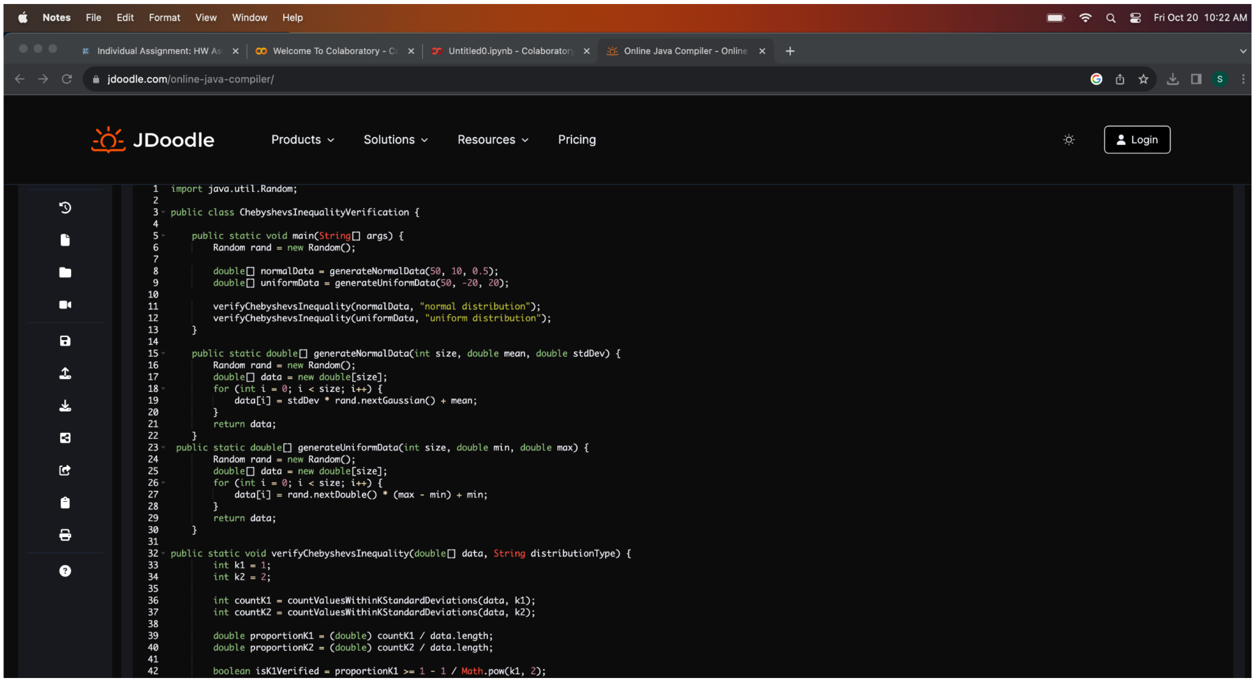
```
Z-Scores: [0.5563042535550173, -1.3979987933204148, 1.642028168485813
Q1: 107.0, Median (Q2): 122.0, Q3: 147.0

Statistics for BloodPressure:
Mean: 68.53333333333333
Variance: 553.0488888888889
Standard Deviation: 23.516991493149987
Z-Scores: [0.1474111460080443, -0.10772352977510916, -0.192768421702827, -0.10772352977510916
Q1: 66.0, Median (Q2): 73.0, Q3: 84.0
```

Question 2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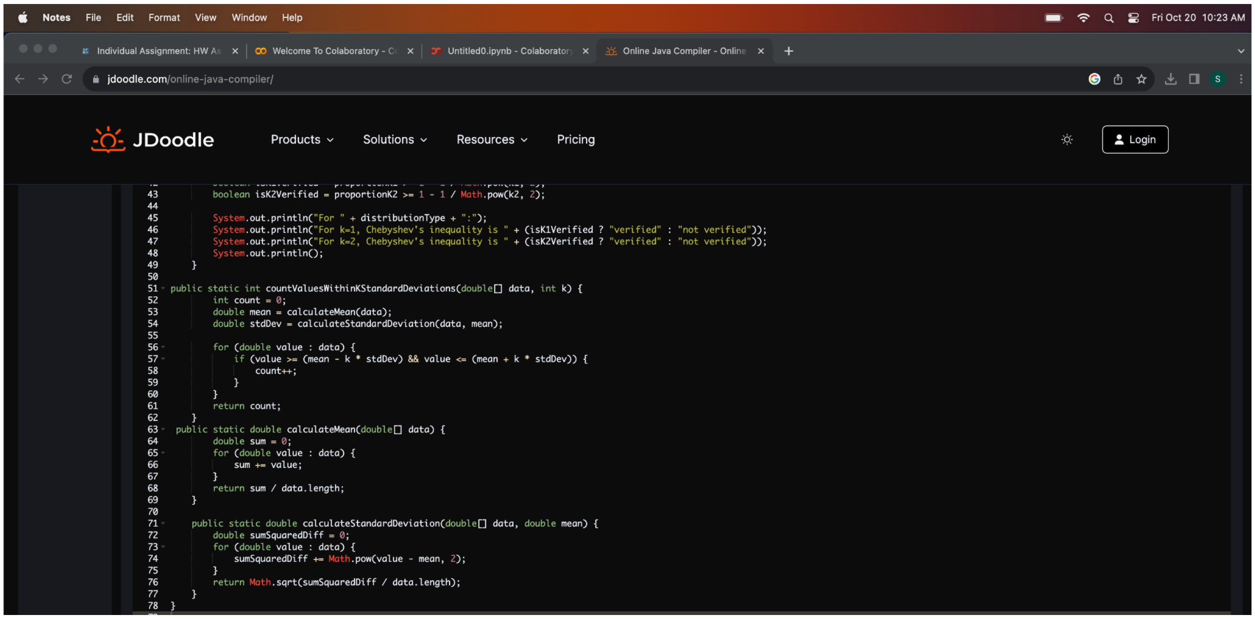
```java
import java.util.Random;

public class ChebyshevsInequalityVerification {

    public static void main(String[] args) {
        Random rand = new Random();

        double[] normalData = generateNormalData(50, 10, 0.5);
        double[] uniformData = generateUniformData(50, -20, 20);

        verifyChebyshevsInequality(normalData, "normal distribution");
        verifyChebyshevsInequality(uniformData, "uniform distribution");
    }

    public static double[] generateNormalData(int size, double mean, double stdDev) {
        Random rand = new Random();
        double[] data = new double[size];
        for (int i = 0; i < size; i++) {
            data[i] = stdDev * rand.nextGaussian() + mean;
        }
        return data;
    }
 public static double[] generateUniformData(int size, double min, double max) {
        Random rand = new Random();
        double[] data = new double[size];
        for (int i = 0; i < size; i++) {
            data[i] = rand.nextDouble() * (max - min) + min;
        }
        return data;
    }

public static void verifyChebyshevsInequality(double[] data, String distributionType) {
        int k1 = 1;
        int k2 = 2;

        int countK1 = countValuesWithinKStandardDeviations(data, k1);
        int countK2 = countValuesWithinKStandardDeviations(data, k2);

        double proportionK1 = (double) countK1 / data.length;
        double proportionK2 = (double) countK2 / data.length;

        boolean isK1Verified = proportionK1 >= 1 - 1 / Math.pow(k1, 2);
```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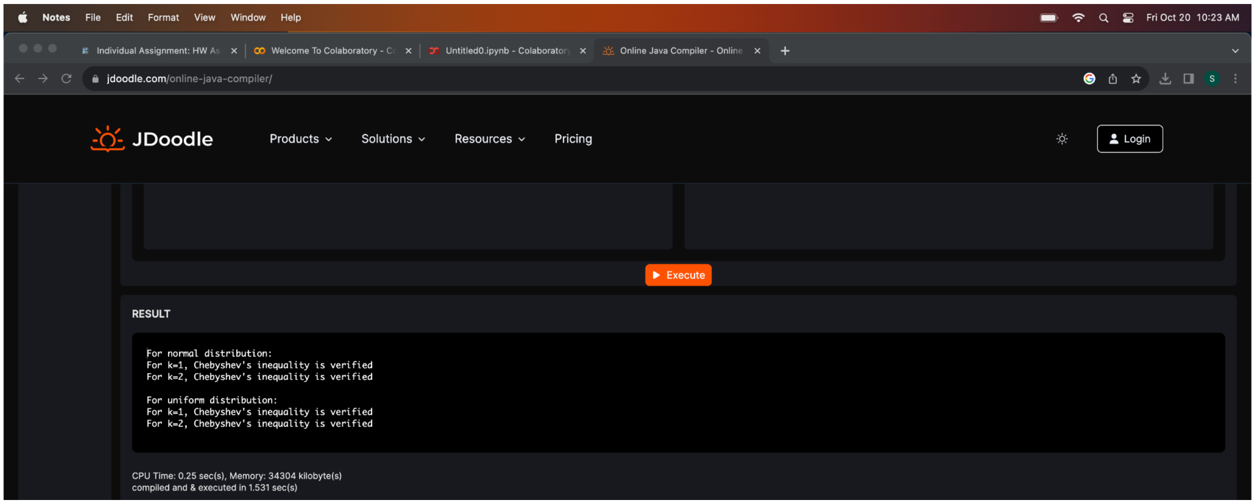
```java
        boolean isK2Verified = proportionK2 >= 1 - 1 / Math.pow(k2, 2);

        System.out.println("For " + distributionType + ":");
        System.out.println("For k=1, Chebyshev's inequality is " + (isK1Verified ? "verified" : "not verified"));
        System.out.println("For k=2, Chebyshev's inequality is " + (isK2Verified ? "verified" : "not verified"));
        System.out.println();
    }

public static int countValuesWithinKStandardDeviations(double[] data, int k) {
        int count = 0;
        double mean = calculateMean(data);
        double stdDev = calculateStandardDeviation(data, mean);

        for (double value : data) {
            if (value >= (mean - k * stdDev) && value <= (mean + k * stdDev)) {
                count++;
            }
        }
        return count;
    }
 public static double calculateMean(double[] data) {
        double sum = 0;
        for (double value : data) {
            sum += value;
        }
        return sum / data.length;
    }

    public static double calculateStandardDeviation(double[] data, double mean) {
        double sumSquaredDiff = 0;
        for (double value : data) {
            sumSquaredDiff += Math.pow(value - mean, 2);
        }
        return Math.sqrt(sumSquaredDiff / data.length);
    }
}
```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Execute

RESULT

```
For normal distribution:
For k=1, Chebyshev's inequality is verified
For k=2, Chebyshev's inequality is verified

For uniform distribution:
For k=1, Chebyshev's inequality is verified
For k=2, Chebyshev's inequality is verified
```

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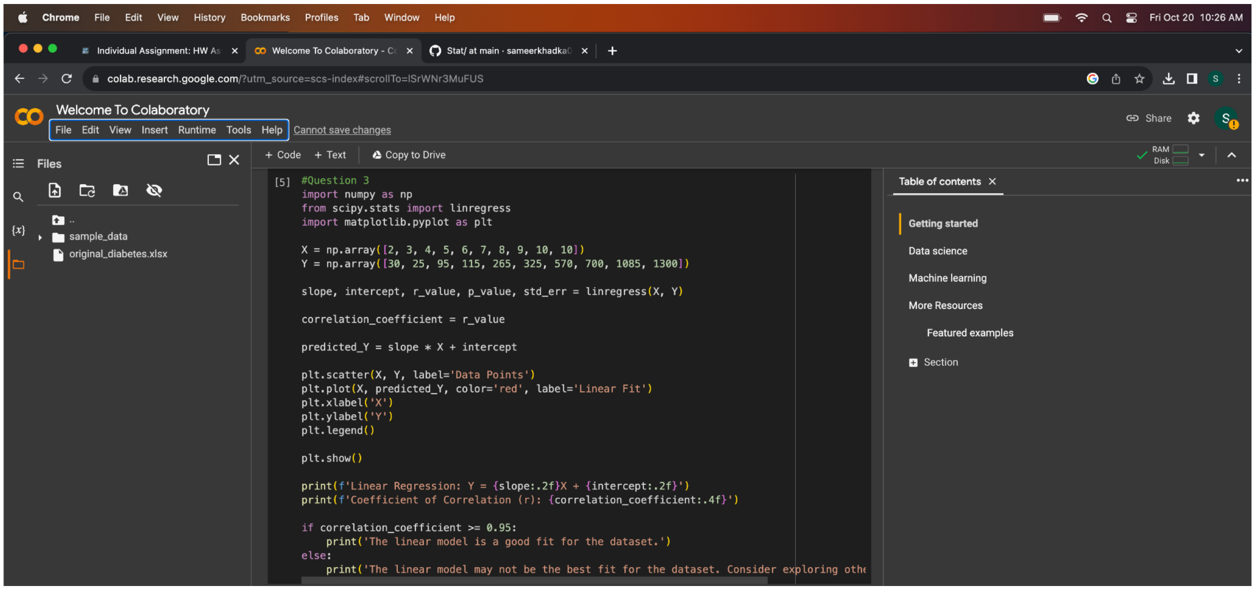
compiled and & executed in 1.531 sec(s)

Question 3



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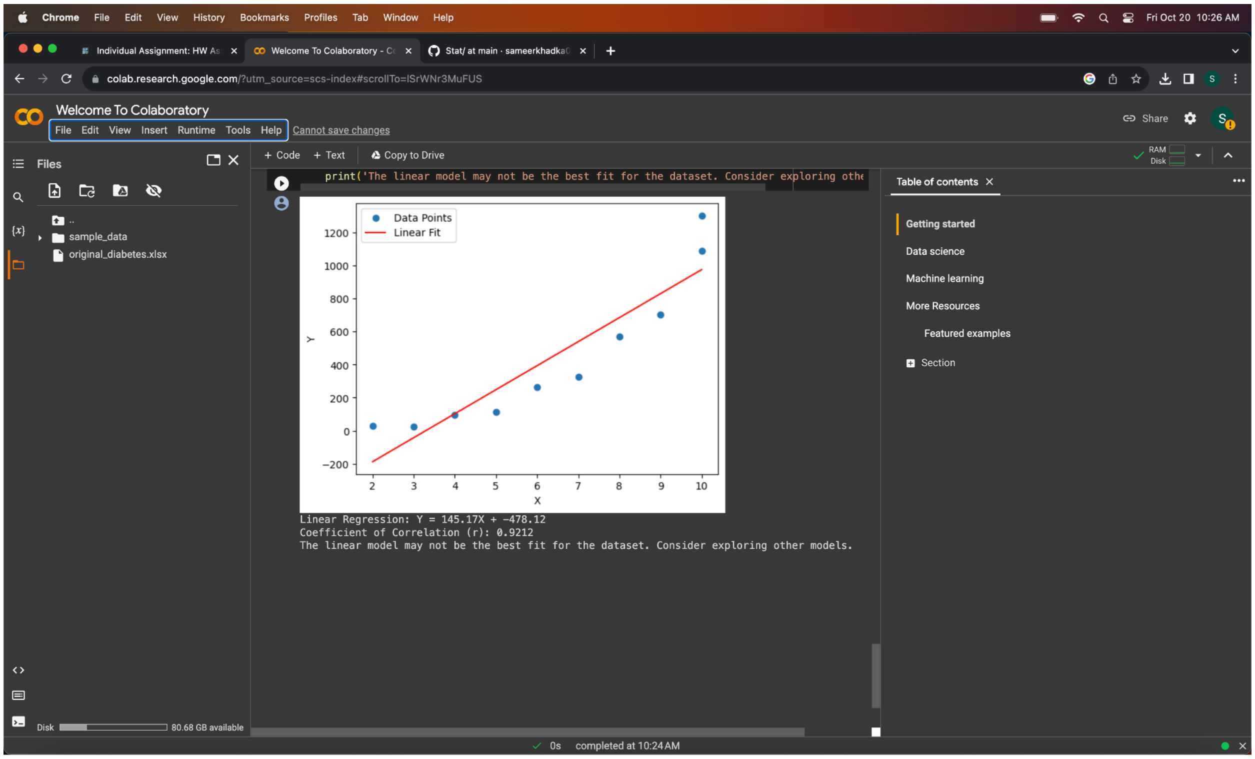
```
[5] #Question 3
    import numpy as np
    from scipy.stats import linregress
    import matplotlib.pyplot as plt

    X = np.array([2, 3, 4, 5, 6, 7, 8, 9, 10, 10])
    Y = np.array([30, 25, 95, 115, 265, 325, 570, 700, 1085, 1300])

    slope, intercept, r_value, p_value, std_err = linregress(X, Y)

    correlation_coefficient = r_value

    predicted_Y = slope * X + intercept

    plt.scatter(X, Y, label='Data Points')
    plt.plot(X, predicted_Y, color='red', label='Linear Fit')
    plt.xlabel('X')
    plt.ylabel('Y')
    plt.legend()

    plt.show()

    print(f'Linear Regression: Y = {slope:.2f}X + {intercept:.2f}')
    print(f'Coefficient of Correlation (r): {correlation_coefficient:.4f}')

    if correlation_coefficient >= 0.95:
        print('The linear model is a good fit for the dataset.')
    else:
        print('The linear model may not be the best fit for the dataset. Consider exploring othe
```



```
        print('The linear model may not be the best fit for the dataset. Consider exploring othe
```

```
Linear Regression: Y = 145.17X + -478.12
Coefficient of Correlation (r): 0.9212
The linear model may not be the best fit for the dataset. Consider exploring other models.
```