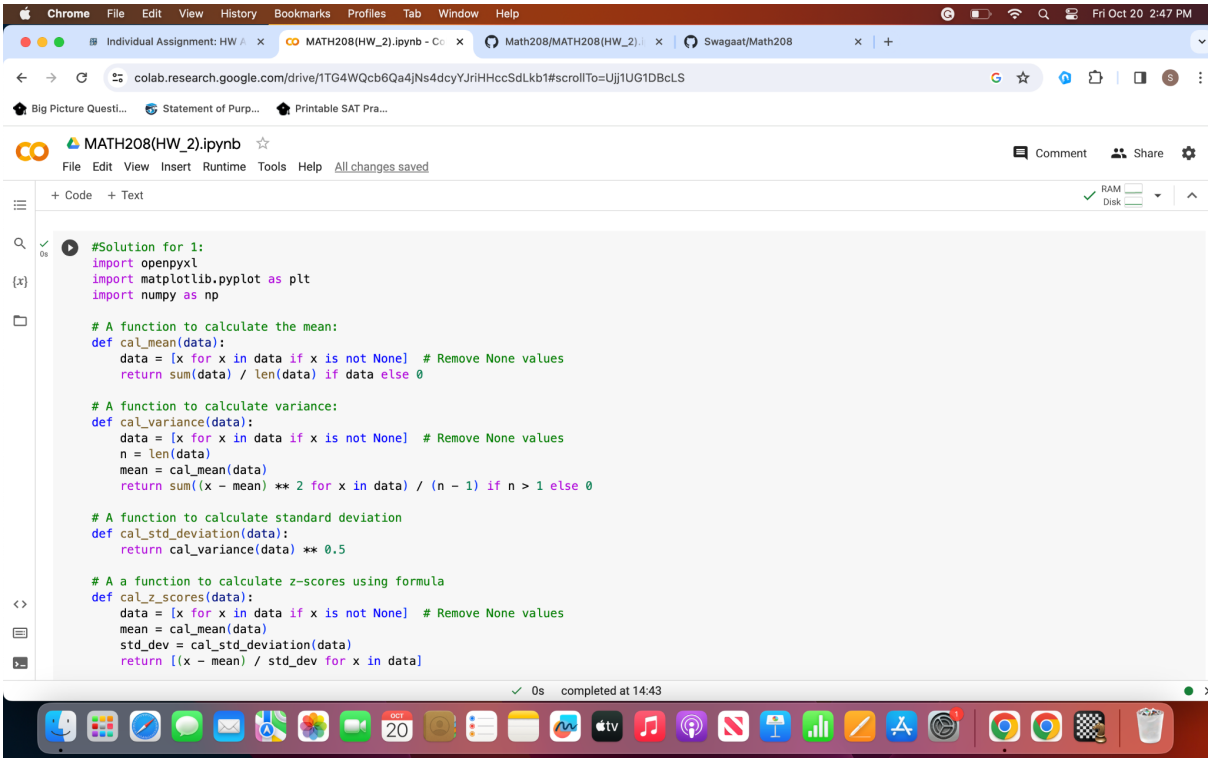
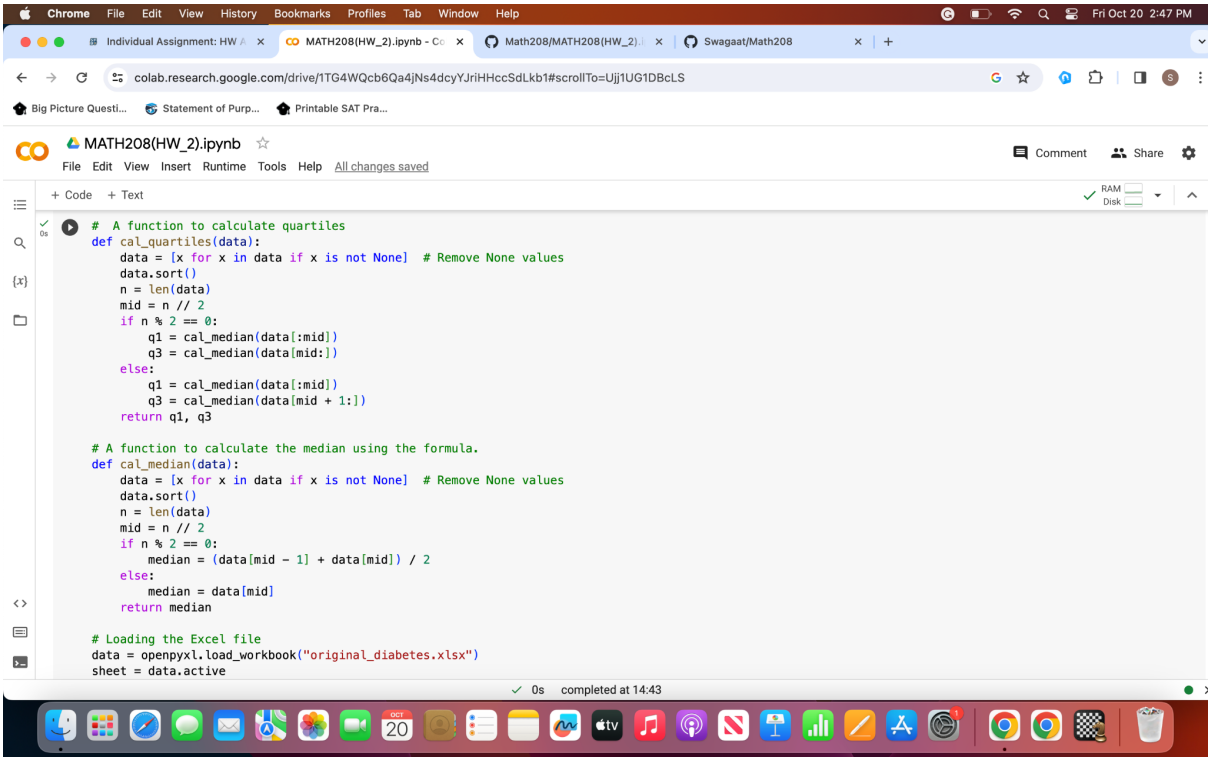
Assignment 2
Name- Swagat Neupane
ID- 19698ns
San Francisco Bay university
Course : MATH208 - Probability and Statistics

Solution-1:

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# A function to calculate quartiles
def cal_quartiles(data):
data = [x for x in data if x is not None] # Remove None values
data.sort()
n = len(data)
mid = n // 2
if n % 2 == 0:
q1 = cal_median(data[:mid])
q3 = cal_median(data[mid:])
else:
q1 = cal_median(data[:mid])
q3 = cal_median(data[mid + 1:])
return q1, q3
# A function to calculate the median using the formula.
def cal_median(data):
data = [x for x in data if x is not None] # Remove None values
data.sort()
n = len(data)
mid = n // 2
if n % 2 == 0:
median = (data[mid - 1] + data[mid]) / 2
else:
median = data[mid]
return median
# Loading the Excel file
data = openpyxl.load_workbook("original_diabetes.xlsx")
sheet = data.active
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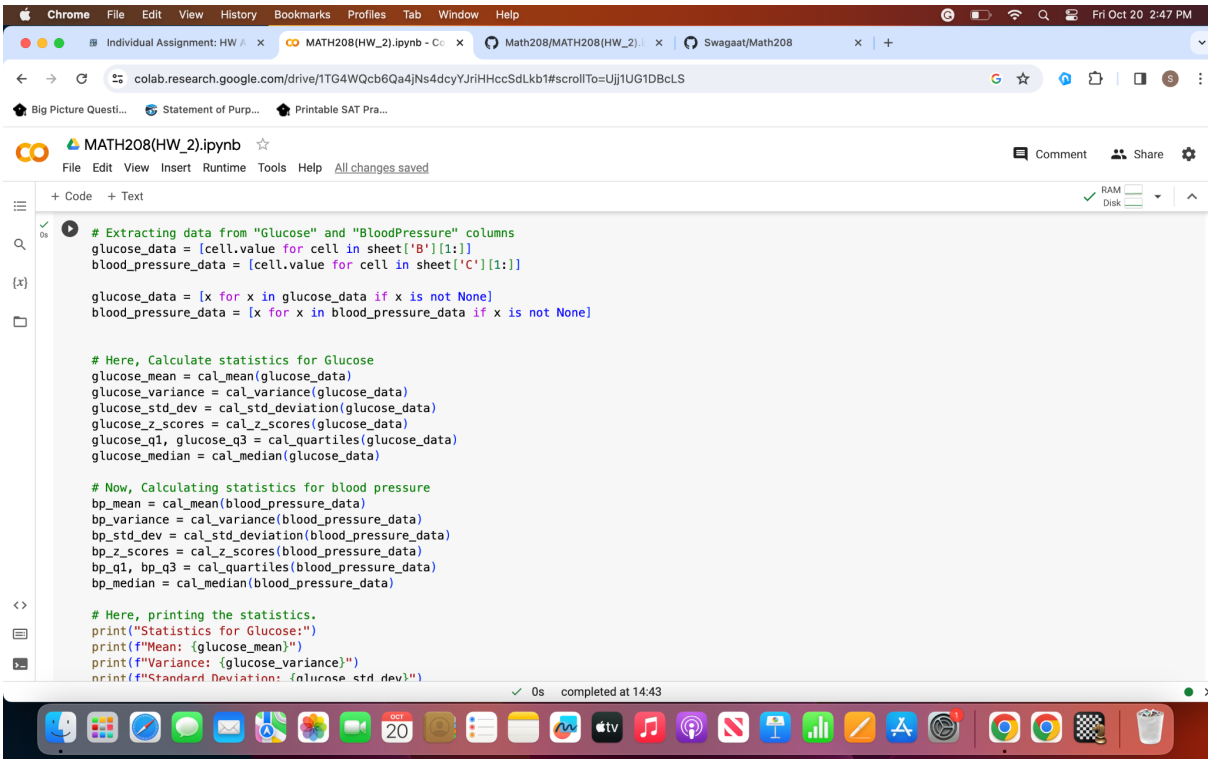
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# Extracting data from "Glucose" and "BloodPressure" columns
glucose_data = [cell.value for cell in sheet['B'][1:]]
blood_pressure_data = [cell.value for cell in sheet['C'][1:]]
glucose_data = [x for x in glucose_data if x is not None]
blood_pressure_data = [x for x in blood_pressure_data if x is not None]
# Here, Calculate statistics for Glucose
glucose_mean = cal_mean(glucose_data)
glucose_variance = cal_variance(glucose_data)
glucose_std_dev = cal_std_deviation(glucose_data)
glucose_z_scores = cal_z_scores(glucose_data)
glucose_q1, glucose_q3 = cal_quartiles(glucose_data)
glucose_median = cal_median(glucose_data)
# Now, Calculating statistics for blood pressure
bp_mean = cal_mean(blood_pressure_data)
bp_variance = cal_variance(blood_pressure_data)
bp_std_dev = cal_std_deviation(blood_pressure_data)
bp_z_scores = cal_z_scores(blood_pressure_data)
bp_q1, bp_q3 = cal_quartiles(blood_pressure_data)
bp_median = cal_median(blood_pressure_data)
# Here, printing the statistics.
print("Statistics for Glucose:")
print(f"Mean: {glucose_mean}")
print(f"Variance: {glucose_variance}")
print(f"Standard Deviation: {glucose_std_dev}")
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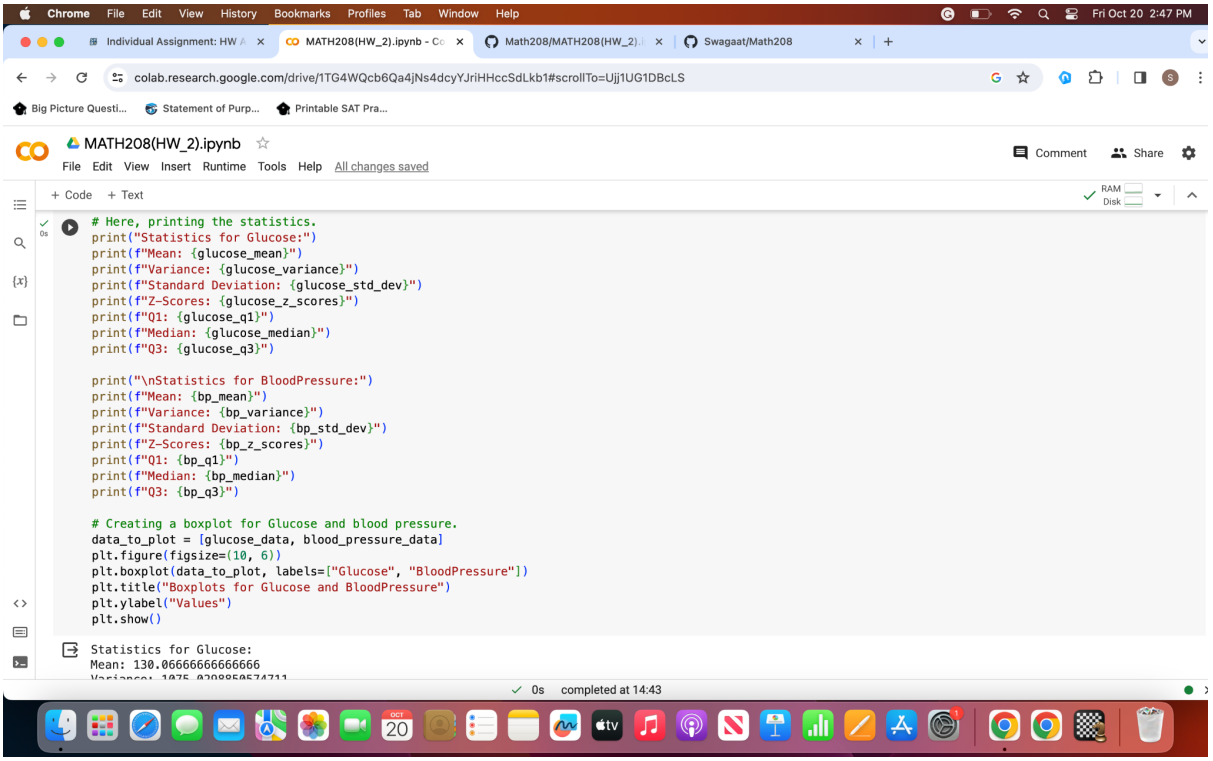
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# Here, printing the statistics.
print("Statistics for Glucose:")
print(f"Mean: {glucose_mean}")
print(f"Variance: {glucose_variance}")
print(f"Standard Deviation: {glucose_std_dev}")
print(f"Z-Scores: {glucose_z_scores}")
print(f"Q1: {glucose_q1}")
print(f"Median: {glucose_median}")
print(f"Q3: {glucose_q3}")
print("\nStatistics 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}")
print(f"Median: {bp_median}")
print(f"Q3: {bp_q3}")
# Creating a boxplot for Glucose and blood pressure.
data_to_plot = [glucose_data, blood_pressure_data]
plt.figure(figsize=(10, 6))
plt.boxplot(data_to_plot, labels=["Glucose", "BloodPressure"])
plt.title("Boxplots for Glucose and BloodPressure")
plt.ylabel("Values")
plt.show()
Statistics for Glucose:
Mean: 130.06666666666666
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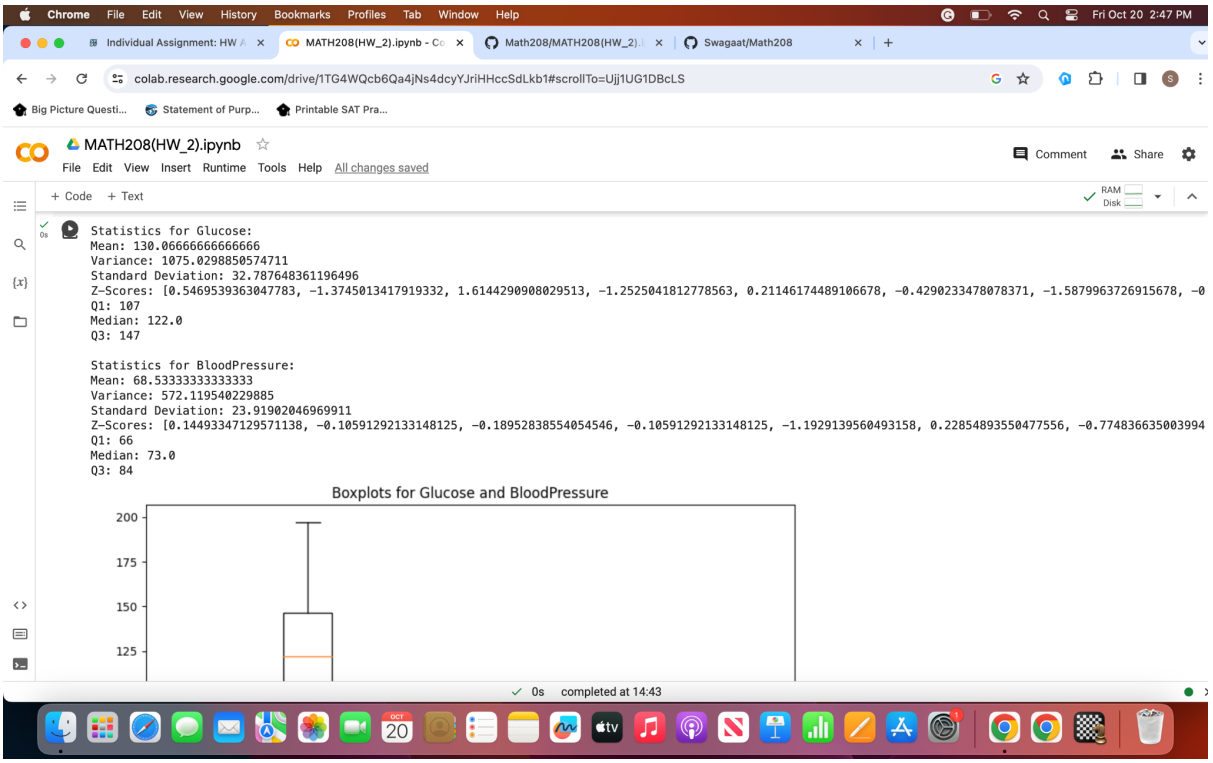
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Statistics for Glucose:
Mean: 130.06666666666666
Variance: 1075.0298850574711
Standard Deviation: 32.787648361196496
Z-Scores: [0.5469539363047783, -1.3745013417919332, 1.6144290908029513, -1.2525041812778563, 0.21146174489106678, -0.4290233478078371, -1.5879963726915678, -0
Q1: 107
Median: 122.0
Q3: 147
Statistics for BloodPressure:
Mean: 68.53333333333333
Variance: 572.119540229885
Standard Deviation: 23.91902046969911
Z-Scores: [0.14493347129571138, -0.10591292133148125, -0.18952838554054546, -0.10591292133148125, -1.1929139560493158, 0.22854893550477556, -0.774836635003994
Q1: 66
Median: 73.0
Q3: 84
Boxplots for Glucose and BloodPressure
200
175
150
125
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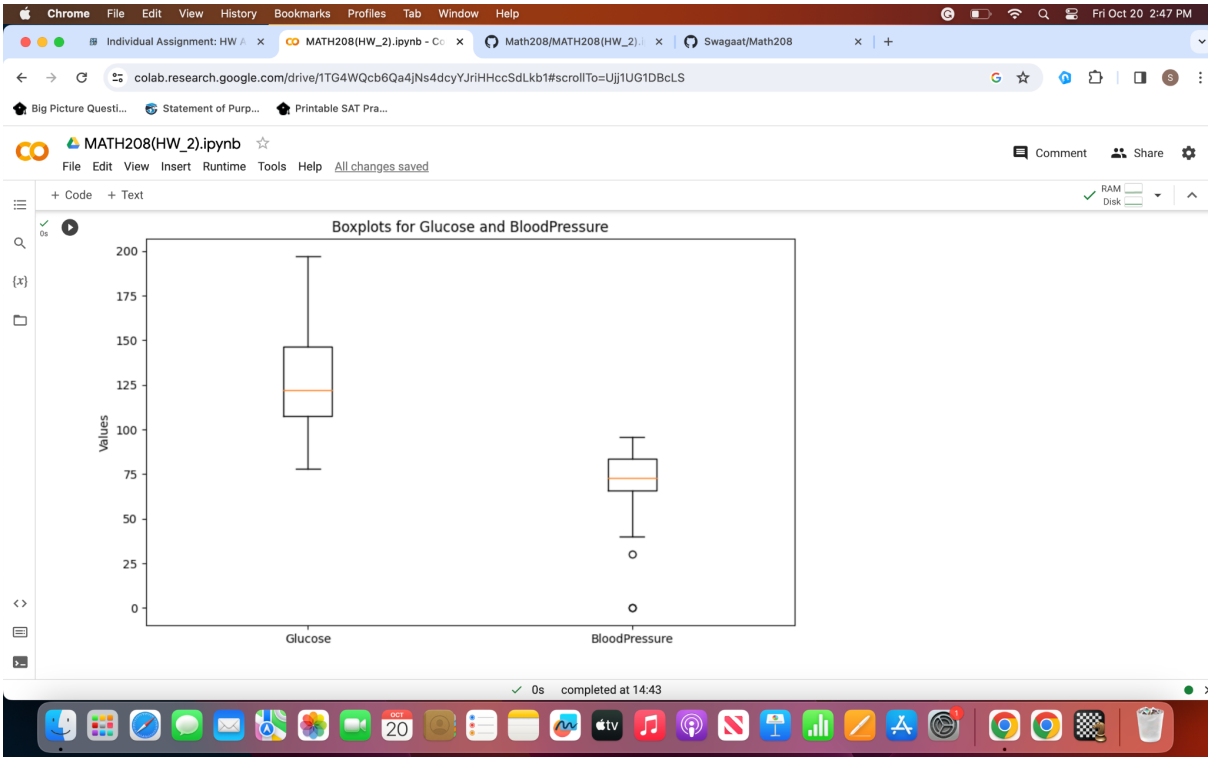
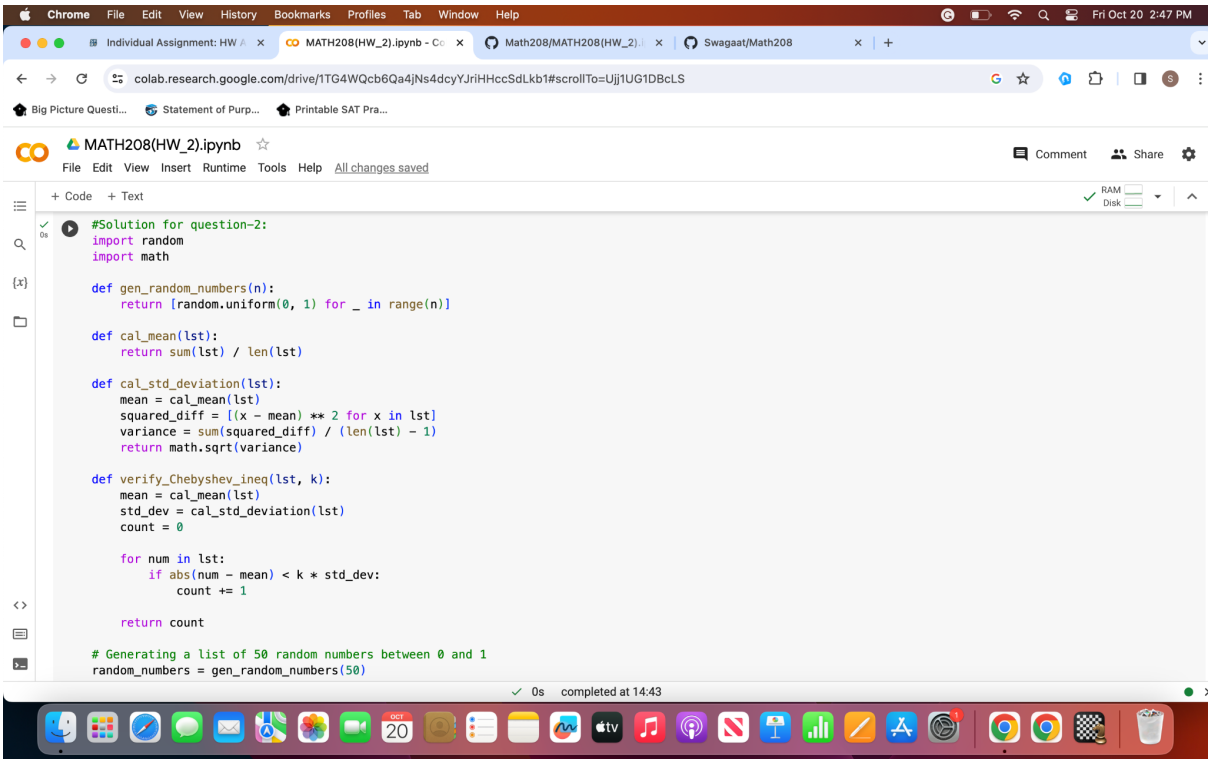
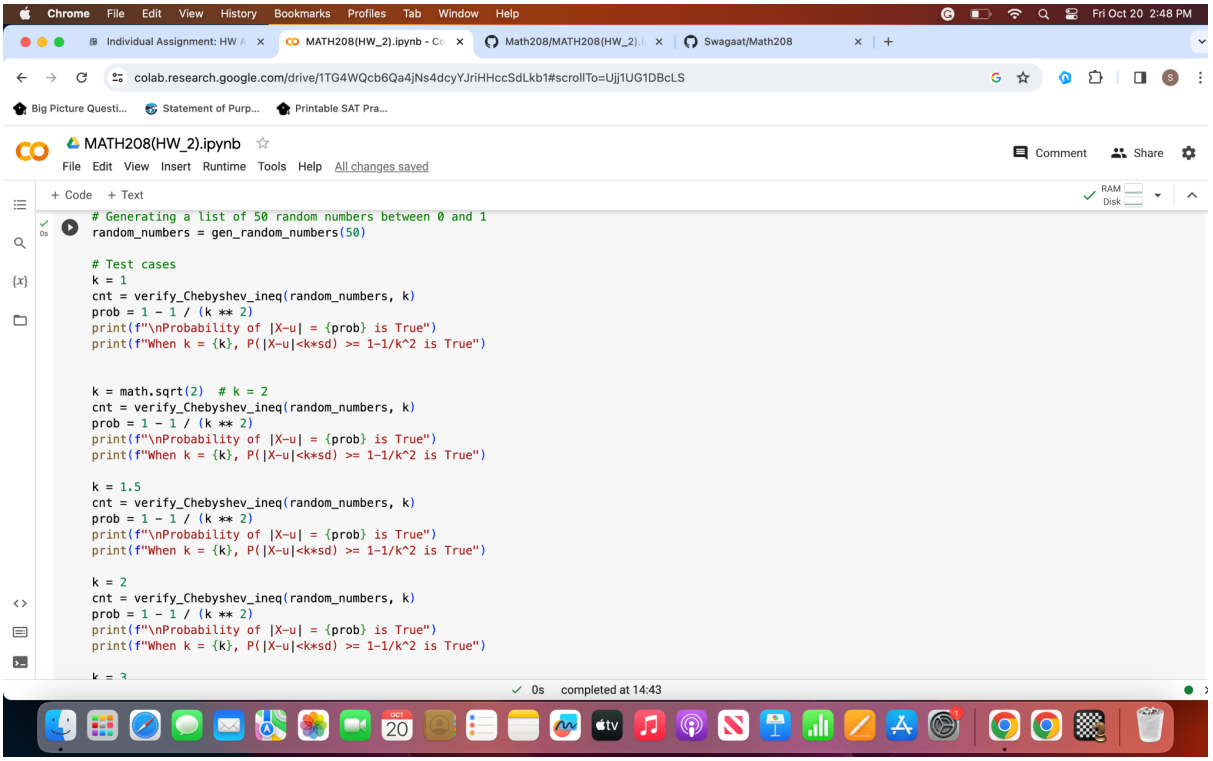


Solution-2:



```python
#Solution for question-2:
import random
import math

def gen_random_numbers(n):
    return [random.uniform(0, 1) for _ in range(n)]

def cal_mean(lst):
    return sum(lst) / len(lst)

def cal_std_deviation(lst):
    mean = cal_mean(lst)
    squared_diff = [(x - mean) ** 2 for x in lst]
    variance = sum(squared_diff) / (len(lst) - 1)
    return math.sqrt(variance)

def verify_Chebyshev_ineq(lst, k):
    mean = cal_mean(lst)
    std_dev = cal_std_deviation(lst)
    count = 0

    for num in lst:
        if abs(num - mean) < k * std_dev:
            count += 1

    return count

# Generating a list of 50 random numbers between 0 and 1
random_numbers = gen_random_numbers(50)
```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# Generating a list of 50 random numbers between 0 and 1
random_numbers = gen_random_numbers(50)
# Test cases
k = 1
cnt = verify_Chebyshev_ineq(random_numbers, k)
prob = 1 - 1 / (k ** 2)
print(f"\nProbability of |X-u| = {prob} is True")
print(f"When k = {k}, P(|X-u|<k*sd) >= 1-1/k^2 is True")
k = math.sqrt(2) # k = 2
cnt = verify_Chebyshev_ineq(random_numbers, k)
prob = 1 - 1 / (k ** 2)
print(f"\nProbability of |X-u| = {prob} is True")
print(f"When k = {k}, P(|X-u|<k*sd) >= 1-1/k^2 is True")
k = 1.5
cnt = verify_Chebyshev_ineq(random_numbers, k)
prob = 1 - 1 / (k ** 2)
print(f"\nProbability of |X-u| = {prob} is True")
print(f"When k = {k}, P(|X-u|<k*sd) >= 1-1/k^2 is True")
k = 2
cnt = verify_Chebyshev_ineq(random_numbers, k)
prob = 1 - 1 / (k ** 2)
print(f"\nProbability of |X-u| = {prob} is True")
print(f"When k = {k}, P(|X-u|<k*sd) >= 1-1/k^2 is True")
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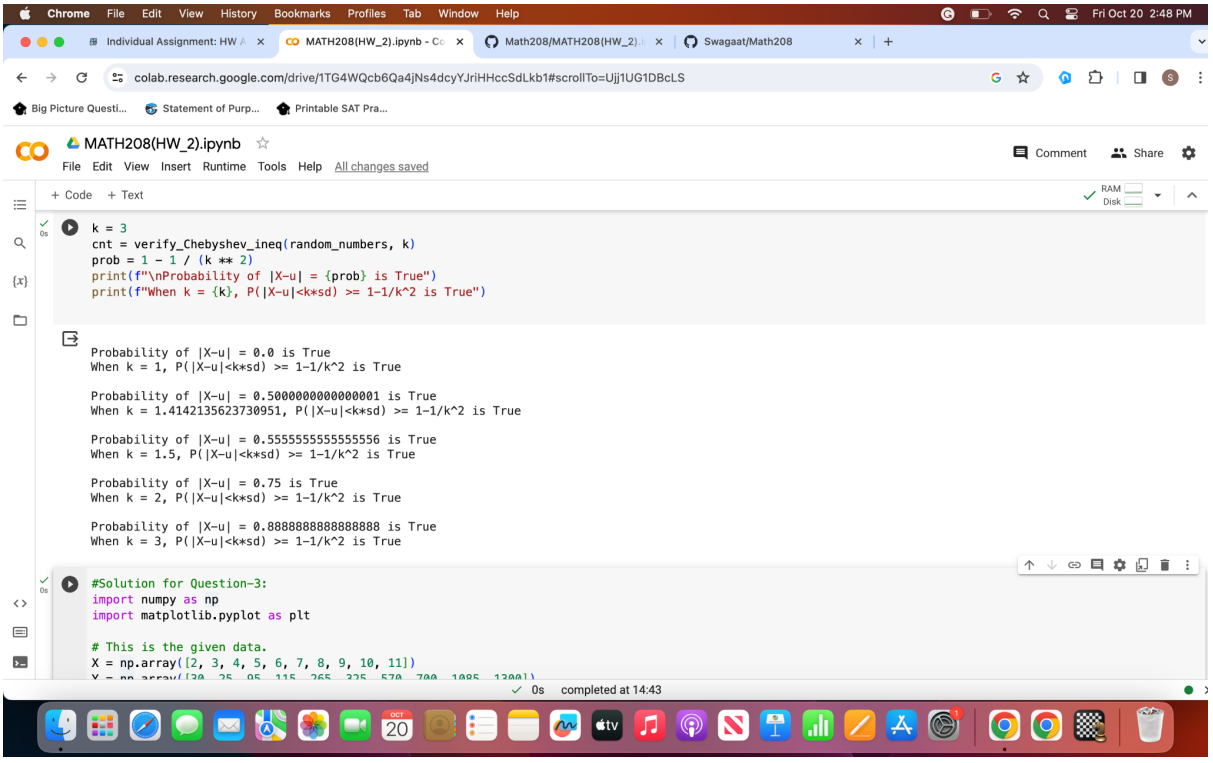
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k = 3
cnt = verify_Chebyshev_ineq(random_numbers, k)
prob = 1 - 1 / (k ** 2)
print(f"\nProbability of |X-u| = {prob} is True")
print(f"When k = {k}, P(|X-u|<k*sd) >= 1-1/k^2 is True")
Probability of |X-u| = 0.0 is True
When k = 1, P(|X-u|<k*sd) >= 1-1/k^2 is True
Probability of |X-u| = 0.5000000000000001 is True
When k = 1.4142135623730951, P(|X-u|<k*sd) >= 1-1/k^2 is True
Probability of |X-u| = 0.5555555555555556 is True
When k = 1.5, P(|X-u|<k*sd) >= 1-1/k^2 is True
Probability of |X-u| = 0.75 is True
When k = 2, P(|X-u|<k*sd) >= 1-1/k^2 is True
Probability of |X-u| = 0.8888888888888888 is True
When k = 3, P(|X-u|<k*sd) >= 1-1/k^2 is True
#Solution for Question-3:
import numpy as np
import matplotlib.pyplot as plt
# This is the given data.
X = np.array([2, 3, 4, 5, 6, 7, 8, 9, 10, 11])
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Solution-3:

MATH208(HW_2).ipynb

```
#Solution for Question-3:
import numpy as np
import matplotlib.pyplot as plt

# This is the given data.
X = np.array([2, 3, 4, 5, 6, 7, 8, 9, 10, 11])
Y = np.array([30, 25, 95, 115, 265, 325, 570, 700, 1085, 1300])

# Here, calculating the coefficient of b1 and b0
n = len(X)
mean_X = sum(X)/len(X)
mean_Y = sum(Y)/len(Y)
b1 = np.sum((X - mean_X) * (Y - mean_Y)) / np.sum((X - mean_X) ** 2)
b0 = mean_Y - b1 * mean_X

# Using the formula calculating the coefficient of linear correlation r.
numerator = np.sum((X - mean_X) * (Y - mean_Y))
denominator_X = np.sqrt(np.sum((X - mean_X) ** 2))
denominator_Y = np.sqrt(np.sum((Y - mean_Y) ** 2))
r = numerator / (denominator_X * denominator_Y)

# Printing the output.
print("b1 (Slope):", b1)
print("b0 (Intercept):", b0)
print("Coefficient of Linear Correlation (r):", r)

# Now, Ploting the data and the straight fitting line
plt.scatter(X, Y, color='blue', label='Data')
Y_pred = b0 + b1 * X
```

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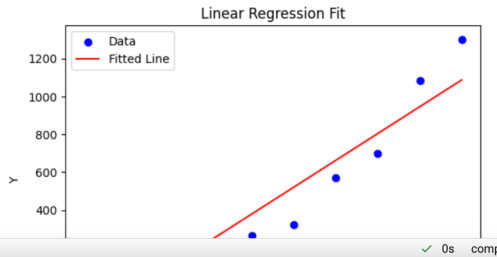
MATH208(HW_2).ipynb

```
# Now, Ploting the data and the straight fitting line
plt.scatter(X, Y, color='blue', label='Data')
Y_pred = b0 + b1 * X
plt.plot(X, Y_pred, color='red', label='Fitted Line')
plt.xlabel('X')
plt.ylabel('Y')
plt.legend()
plt.title('Linear Regression Fit')
plt.show()
```

```
b1 (Slope): 141.21212121212122
b0 (Intercept): -466.8787878787879
Coefficient of Linear Correlation (r): 0.943579551890278
```



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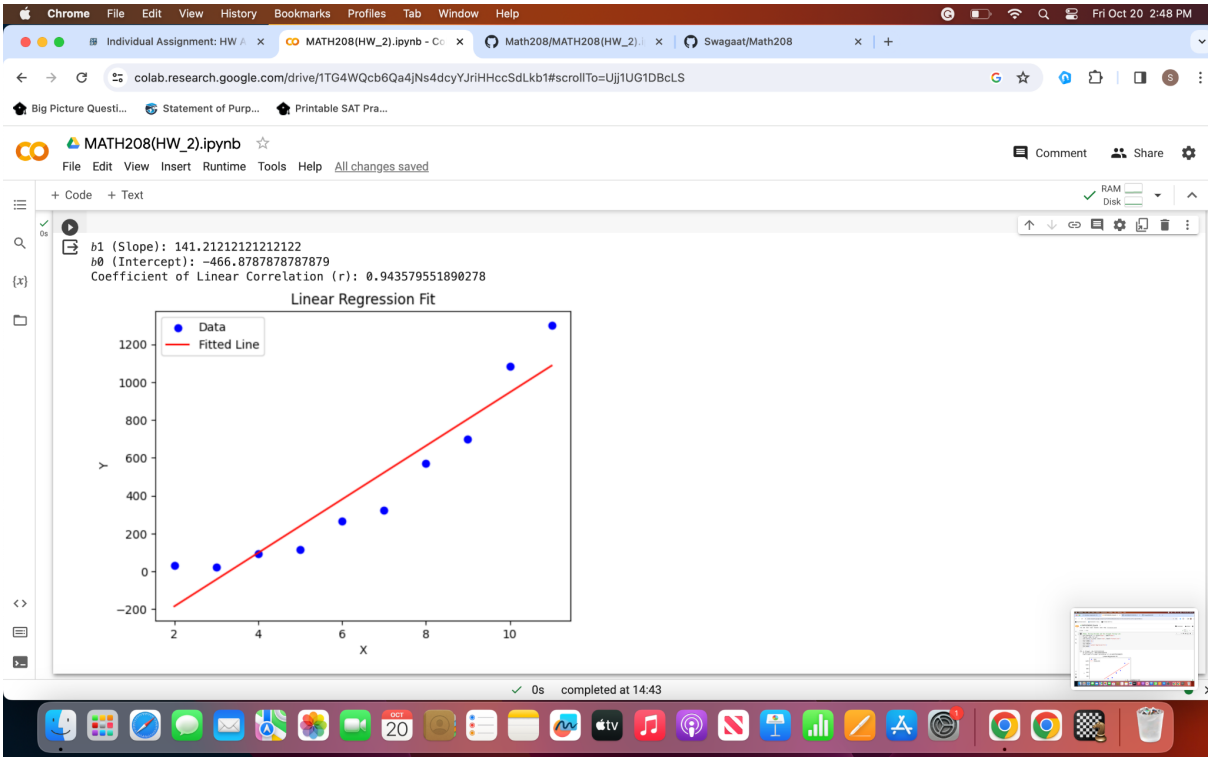
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b1 (Slope): 141.21212121212122
b0 (Intercept): -466.8787878787879
Coefficient of Linear Correlation (r): 0.943579551890278
Linear Regression Fit
Data
Fitted Line
1200
1000
800
600
400
200
0
−200
Y
2
4
6
8
10
X
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