



# Symbiosis University of Applied Sciences, Indore

India's First Skill University

## **SKILL JOURNAL**

Enrollment Number – 2019BTCS088

Year of Enrollment – 2019-2023

Name of the Student – YASH GUPTA

School of      COMPUTER SCIENCE & INFORMATION TECHNOLOGY

Program – B. TECH

Specialization/ Branch – CS&IT

Semester – 4<sup>TH</sup>      Section – B2      Branch – CS&IT

Paper Code – BTCS04CFB2      Name of Paper – Statistics-II

Faculty-In-Charge – DEVENDRA CHOUHAN SIR

# **CERTIFICATE**

**THE SKILL EXPERIMENTS  
ENTERED IN THIS JOURNAL HAVE BEEN  
SATISFACTORY PERFORMED BY**

**ENROLLMENT NO - 2019BTCS088 MR/MS YASH GUPTA  
STUDYING IN PROGRAM B. TECH BRANCH CS&IT IN  
SCHOOL OF COMPUTER SCIENCE & INFORMATION  
TECHNOLOGY  
DURING SEMESTER 4<sup>TH</sup> OF ACADEMIC YEAR 2020-2021**

---

(                      )

**Date:** \_\_\_\_\_

## INDEX

# SKILL ACTIVITY NO: 1

(Mean Deviation about Mean Median Mode for all 3 types of Series with MATLAB)

Date: 15<sup>th</sup> June 2021

## SKILL ACTIVITY-01

Date: 15<sup>th</sup> June 2021

TITLE: Mean Deviation <sup>from</sup> Mean, Median, Mode for all 3 types of Series using MATLAB

1. What is the purpose of this Activity? (Explain in 3-4 lines)

Purpose of this Activity is to find out:-

↳ what is Mean Deviation? Why we need it?

↳ Need of Mean Deviation in Real world use-case.

↳ How to find Mean Deviation?

↳ How to find mean-deviation <sup>from</sup> all 3 central tendency values along with for all 3 types of Series.

2. Steps performed in this Activity? (Explain in 5-6 lines)

(a) For finding Mean Deviation from Mean

(i) Individual Series

↳ Step① Store the dataset in the variable "x".

↳ Step② Find the mean using mean() of Matlab.

↳ Step③ Find the absolute of ~~x~~ X-Mean i.e.

Absolute Deviation from mean  
(i.e.  $|x - \bar{x}|$ )

↳ Step④ Find the sum of Absolute Deviation from Mean

↳ Step⑤ Use below formula to find Mean Deviation i.e.

$$M.D = \frac{\sum |x - \bar{x}|}{n} \quad \text{Total No. of observations in } x,$$

(ii) for finding Mean Deviation for

(b) Discrete Series

↳ Step①: Here, we have provided frequency of each observation.

↳ Step②: So first we will find product of frequency &  $x$ : & find sum of it.

↳ Step③ Find the Absolute Deviation from mean i.e.  $|x - \bar{x}|$

↳ Step④ Multiply frequency with the Abs. Deviation from Mean.

↳ Step⑤ Find sum of above product.

↳ Step⑥ Use below formula to find Mean Deviation i.e.

$$M.D = \frac{\sum f |x - \bar{x}|}{\sum f} \quad \begin{matrix} \leftarrow \text{sum of frequencies of} \\ \text{all observations} \end{matrix}$$

### (c) Continuous Series

↳ Here, class intervals are provided in question with their corresponding frequencies. So

Step① → First find out the MID-POINT (value) from class interval using  $(\text{Upper Limit} + \text{Lower Limit}) = \text{Mid value}$

Step② → Now, store the Mid values  $\rightarrow$  as  $x^*$  & their respective frequencies as  $f^*$

Step③ → Find the Absolute Deviation from mean i.e.  $|x - \bar{x}|$

Step④ → Multiply frequency with Absolute Deviation from about Mean.

Step⑤ → Find sum of above product.

Step⑥ → Use below formula to find Mean Deviation i.e.

$$M.D = \frac{\sum f_i |x_i - \bar{x}|}{\sum f_i}$$

→ Sum of frequencies of all observations.

### (b) For finding Mean Deviation from Median

#### a) Individual Series

↳ Step① Store the dataset in the variable "x"

↳ Step② Arrange the dataset in any order. (using sort())

↳ Step③ Find median using median() :-

↳ Step④ Find the Absolute Deviation from Median i.e.  $|x - \text{Median}|$

↳ Step⑤ Find the sum of Absolute Deviation from Median.

↳ Step⑥ Use below formula to find Mean Deviation abt Median  
i.e.  $M.D = \frac{\sum |x - \text{Median}|}{n}$

#### b) Discrete Series

↳ Step① Here we have provided respective frequency of each observation.

↳ Step② First arrange the dataset in definite Order along with frequency. using sort()

↳ Step③ Then find cumulative frequency. (c.f) using cumsum(),

↳ Step④ Find the median using mathematical formula according to the length of "x".

$$M.D = \frac{\sum f_i |x - \text{Median}|}{\sum f_i}$$

(c) Continuous Series → Here class intervals are given with their corresponding frequencies.

→ Step① First

find the cumulative frequency (c.f) using cumulative. B  
also find the mid-value ( $\frac{x_1 + x_2}{2}$ ) from class interval.

→ Step② Find the median term using formula  $\Rightarrow \left( \frac{\frac{N}{2} - c.f}{f} \right)$

→ Step③ From above step we get our Median Class.

→ Step④ Now apply Mathematical Formula & find out Median

$$\text{Median} = \frac{l + \left( \frac{N}{2} - c.f \right) * h}{f}$$

→ Step⑤ Now perform all the same steps we done in Discrete series..

(c) For finding Mean Deviation from Mode

a. Individual Series

→ Step①: State the dataset ( $x$ ) in one variable.

→ Step②: Find the mode of " $x$ " using mode().

→ Step③ Then find the Absolute Deviations about Mode using  $|x - \text{Mode}(x)|$

→ Step④: Find the sum of Absolute Deviations about Mode by using sum() function.

→ Step⑤: Use below formula to find Mean Deviation i.e.

$$M.D = \frac{\sum |x - \text{Mode}(x)|}{\text{total No. of observations in } x}$$

b. Discrete Series

→ Step①: Here, we have provided respective frequency of each observation.

→ Step②: Concat both of the arrays i.e. " $x$ " and " $f$ " into one array.

→ Step③: Find mode by performing one MATLAB operation on the concatenated array, i.e.

$$\text{Array} = (X(X(:,2) == \max(X(:,2)), :))$$

→ Step④ Find the Absolute Deviations about mode & multiply with freq

→ Step⑤ Find sum of Abs. Deviations

→ Step⑥ Use below formula to find Mean Deviation i.e.

$$M.D = \frac{\sum f_i (|x - \text{Mode}(x)|)}{\sum f_i}$$

### Continuous Series

↳ Step①: Here, Class Intervals are provided in question with their corresponding frequencies.

↳ Step②: First find out the MID-Value from class interval using  
$$\text{Mid-value} = (\text{Upper-Limit} + \text{lower-Limit})/2$$

↳ Step③: Store the mid-values as 'x' & their respective frequencies as 'f'

↳ Step④: Finding the Model Class by finding Highest frequency using same operation we done in Discrete Series.

↳ Step⑤: Find the Mode using mathematical formula

$$\text{Mode} = L + \left( \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \cdot h$$

↳ Step⑥: Find Absolute Deviation about Mode using

$|x - \text{Mode}(x)|$   
↳ Step⑦: Finding sum of Absolute Deviation about Mode using sum()

↳ Step⑧: Use below formula to find Mean Deviation i.e.

$$M.D = \frac{\sum f_i |x - \text{Mode}(x)|}{\sum f_i}$$

3. What Resources/Equipment's/Tools/Materials did you use for this activity?

- Matlab 30 days trial software (2020)
- Matlab Online Help Documentation

4. What skills did you acquire?

↳ Get to know about what why when to use Mean Deviation?

↳ Application of Mean Deviation

↳ How to create code in MATLAB for mean deviation abt Mean, Median, Mode

↳ Use of mean(), median(), mode(), function.

5. Time taken to complete this Activity? 03:00 (HOURS)

  
Yogurt

Signature of Student

## (To be filled by Faculty)

Sr. No.	Skill /Competencies	(Achieved / Not Achieved) (Yes / No)

Remarks :

Total mark \_\_\_\_\_ out of 10.

Signature of Faculty

Date: \_\_\_\_\_

## Details of Activity:

### MATLAB CODE:

#### A. Example 1: Mean Deviation about Mean for Individual Series

The screenshot shows the MATLAB Live Editor interface. The code is for calculating Mean Deviation about Mean for S&P500 stock prices over five years. It includes comments explaining each step: Step 1 (storing data), Step 2 (finding mean), Step 3 (finding absolute deviation), and Step 4 (finding sum of absolute deviation). The output shows the stock price matrix and a table of absolute deviations from the mean.

```
Matlab_Skill_Activity_01_performed_by_YASH_GUPTA_2019BTCS088
Write MATLAB code for finding Mean Deviation about the Mean for all 3 types of Series

Question: Stock Price list of S&P500 is given for 5 consecutive years (2017-21)
S&P500 = [1691.75, 1977.80, 1884.09, 2151.13, 2519.36]

1 clc ; clear all
2 % Solution:
3 % Given : Stock Price list for 5 consecutive years [2017 - 2021]
4 % S&P 500(in $) : [1691.75 , 1977.80, 1884.09, 2151.13, 2519.36] // Individual Series
5
6 % Step 1: Storing X in var SP_500
7 SP_500 = [1691.75 , 1977.80, 1884.09, 2151.13, 2519.36]
8
9 % Step2 : Finding Mean using mean()
10 Mean = mean(SP_500);
11
12 % Step 3 : Finding Absolute Deviation about Mean
13 Abs_Mean = abs(SP_500 - Mean);
14
15 % Step 4 : Finding sum of Absolute Deviation about Mean
16 Sum_Abs_Mean = sum(Abs_Mean);
17
18 % Tabular View
19 Stock_Price = table(SP_500', Abs_Mean');
20 Stock_Price.Properties.VariableNames = {'S&P_500', 'Abs_Mean'}
21
22 % Method 1: Via using traditional mathematical formula finding Mean Deviation about Mean
23 % Mean Deviation = (sum(|X - mean(X)|))/length(X)
24 Mean_Deviation = (Sum_Abs_Mean)/length(SP_500);
25 fprintf('Value of Correlation coefficient (using mean approach) is %f' , Mean_Deviation)
26 %
27
28
29
```

SP\_500 = 1×5  
10<sup>3</sup> ×  
1.6918 1.9778 1.8841 2.1511 2.5194

Stock\_Price = 5×2 table

	S&P_500	Abs_Mean
1	1.6918e+03	353.0760
2	1.9778e+03	67.0260
3	1.8841e+03	160.7360
4	2.1511e+03	106.3040
5	2.5194e+03	474.5340

Value of Correlation coefficient (using mean approach) is 232.335200

#### B. Example 2: Mean Deviation about Mean for Discrete Series

The screenshot shows the MATLAB Live Editor interface. The code is for calculating Mean Deviation about Mean for discrete employee salaries. It includes comments explaining each step: Step 1 (storing data), Step 2 (finding product of X & Frequency), Step 3 (finding mean), Step 4 (finding absolute deviation), and Step 5 (product of frequency & absolute mean). The output shows the salary matrix and a table of absolute deviations from the mean.

```
Matlab_Skill_Activity_01_performed_by_YASH_GUPTA_2019BTCS088
Write MATLAB code for finding Mean Deviation about the Mean for all 3 types of Series

Question: Salaries of 6 employees(in thousand) are given
Salaries : [20 40 100 110 120] ; Frequency : [6, 4, 3, 7, 10, 5]

1 clc ; clear all
2 % Solution:
3 % Given : Salaries of 6 employees(in thousand) are given
4 % Salaries : [20 40 100 110 120]
5 % Frequency : [6, 4, 3, 7, 10, 5]
6
7 % Step 1: Storing X in variable Salaries
8 Salaries = [20 40 100 110 120 150]
9 Frequency = [6, 4, 3, 7, 10, 5] % Discrete Series
10
11 % Step2 : Finding product of X & Frequency
12 Product = (Salaries).*Frequency;
13
14 % Step3 : Finding Mean using mean()
15 Mean = mean(Product);
16
17 % Step4 : Finding Absolute Deviation about Mean
18 Abs_Mean = abs(Product - Mean);
19
20 % Step5: Product of Frequency & Absolute Mean
21 Prod_Abs_Mean = (Frequency).*(Abs_Mean);
22
23 % Step6 : Finding sum of Absolute Deviation about Mean
24 Sum_Abs_Mean = sum(Prod_Abs_Mean);
25
26 % Tabular View
27 Employee_Salaries = table(Salaries',Abs_Mean', Prod_Abs_Mean');
28 Employee_Salaries.Properties.VariableNames = {'Salaries' , 'Abs_Mean' , 'Prod_Abs_Mean'}
29
30 % Method 1: Via using traditional mathematical formula finding Mean Deviation about Mean
31 % Mean Deviation = (sum(|X - mean(X)|))/length(X)
32 Mean_Deviation = (Sum_Abs_Mean)/length(Frequency);
33 fprintf('Value of Correlation coefficient (using mean approach) is %f' , Mean_Deviation)
34 %

Salaries = 1×6  
20 40 100 110 120 150  
Frequency = 1×6  
6 4 3 7 10 5  
Employee_Salaries = 6×3 table
```

	Salaries	Abs_Mean	Prod_Abs_Mean
1	20	30	2500
2	40	30	1500
3	100	250	750
4	110	220	1540
5	120	650	6500
6	150	200	3000

Value of Correlation coefficient (using mean approach) is 398.000000

### C. Example 3: Mean Deviation about Mean for Continuous Series

Matlab\_Skill\_Activity\_01\_performed\_by\_YASH\_GUPTA\_2019BTCS088

Write MATLAB code for finding Mean Deviation about the Mean for all 3 types of Series

Question: Marks of 5 students (out of 20) are given

Class : [0-5 5-10 10-15 15-20 20-25] ; Frequency : [6, 4, 3, 7, 10]

```

1 clc; clear all
2 % Solution:
3 % Given : Marks of 5 Students are given
4 % Class : [0-5 5-10 10-15 15-20 20-25] % Continuous Exclusive Series
5 % Frequency : [6, 4, 3, 7, 10]
6
7 % Step 1: Finding Mid-Value from class interval & storing in Marks variable
8 Marks = [2.5, 7.5, 12.5, 17.5, 22.5];
9 Frequency = [6, 4, 3, 7, 10];
10
11 % Step2 : Finding product of X & frequency
12 Product = (Marks).*(Frequency);
13
14 % Step3 : Finding Mean using mean()
15 Mean = mean(Product);
16
17 % Step4 : Finding Absolute Deviation about Mean
18 Abs_Mean = abs(Product - Mean);
19
20 % Step5: Product of Frequency & Absolute Mean
21 Prod_Abs_Mean = (Frequency).*(Abs_Mean);
22
23 % Step6 : Finding sum of Absolute Deviation about Mean
24 Sum_Abs_Mean = sum(Prod_Abs_Mean);
25
26 % Tabular View
27 Student_Marks = table(Marks', Frequency', Abs_Mean', Prod_Abs_Mean');
28 Student_Marks.Properties.VariableNames = { 'Marks' , 'Frequency' , 'Abs_Mean' , 'Prod_Abs_Mean' };
29
30 % Method 1: Via using traditional mathematical formula finding Mean Deviation about Mean
31 % Mean Deviation = (sum(|X - mean(X)|))/length(X)
32 Mean_Deviation = (Sum_Abs_Mean)./(sum(Frequency));
33 fprintf('Value of Mean Deviation (using mathematical formula approach) is %f' , Mean_Deviation)
34
35 % -----

```

Marks = 1x5  
2.5000 7.5000 12.5000 17.5000 22.5000

Frequency = 1x5  
6 4 3 7 10

Student\_Marks = 5x4 table

	Marks	Frequency	Abs. Mean	Prod. Abs. Mean
1	2.5000	6	71	426
2	7.5000	4	56	224
3	12.5000	3	48.5000	145.5000
4	17.5000	7	36.5000	255.5000
5	22.5000	10	139	1390

Value of Mean Deviation (using mathematical formula approach) is 81.366667

### D. Example 1: Mean Deviation about Median for Individual Series

Matlab\_Skill\_Activity\_01\_performed\_by\_YASH\_GUPTA\_2019BTCS088

Write MATLAB code for finding Mean Deviation about the Median for all 3 types of Series

Question: Pocket money of 5 kids(in \$ monthly basis) are given

Money : [20, 50, 100, 90, 75, 80]

```

1 clc; clear all
2 % Solution:
3 % Given : Pocket Money of 5 kids is given
4 % Pocket_Money : [20, 50, 100, 90, 75] % Individual Series
5
6
7 % Step 1: Storing the X in a variable Pocket_Money
8 Pocket_Money = [20, 50, 100 90 75];
9
10 % Step2 : Sorting the X in ascending order using sort()
11 Sorted_PM = sort(Pocket_Money);
12
13 % Step3 : Finding Median using Mathematical formula
14 Median = median(Sorted_PM);
15 fprintf('Median is %f' , Median);
16
17 % Step4: Finding Absolute Deviation about Mean
18 Abs_Mean = abs(Sorted_PM - Median);
19
20 % Step6 : Finding sum of Absolute Deviation about Median
21 Sum_Abs_Mean = sum(Abs_Mean);
22
23 % Tabular View
24 Student_Marks = table(Pocket_Money', Abs_Mean');
25 Student_Marks.Properties.VariableNames = { 'Pocket Money' , 'Absolute Mean' };
26
27 % Method : Via using traditional mathematical formula finding Mean Deviation about Median
28 % Mean Deviation = (sum(|X - median(X)|))/length(X)
29 Mean_Deviation = (Sum_Abs_Mean)./(length(Sorted_PM));
30 fprintf('Value of Mean Deviation (using mathematical formula approach) is %f' , Mean_Deviation)
31
32 % -----

```

Pocket\_Money = 1x5  
20 50 100 90 75

Median is 75.000000

Student\_Marks = 5x2 table

	Pocket Money	Absolute Mean
1	20	55
2	50	25
3	100	0
4	90	15
5	75	25

Value of Mean Deviation (using mathematical formula approach) is 24.000000

## Example 2: Mean Deviation about Median for Discrete Series

**Matlab\_Skill\_Activity\_01\_performed\_by\_YASH\_GUPTA\_2019BTCS088**

**Write MATLAB code for finding Mean Deviation about the Median for all 3 types of Series**

**Question:** Pocket money of 5 kids(in \$ monthly basis) are given

**Money :** [20, 50, 100, 90, 75] ; **Frequency :** [3, 7, 14, 9, 10, 15, 14]

```

1 clc; clear all
2 % Solution:
3 % Given : Pocket Money of 5 kids is given
4 % Pocket_Money : [20, 50, 100, 90, 75] % Discrete Series
5 % Frequency : [3, 7, 14, 9, 10]
6
7 % Step 1: Sorting the X(Marks in ) using sort() and linking X with its corresponding frequency
8 Pocket_Money = sort([20, 50, 100 90 75])
9 Frequency = [3 7 10 9 14]
10
11 % Step2 : Finding the cummulative frequency using cumsum()
12 CF = cumsum(Frequency)
13
14 % Step3 : Finding Median Term
15 Median_Term = (sum(Frequency)+1)/2;
16 fprintf('Median Term is %f', Median_Term)
17 Table = [Pocket_Money', Frequency', CF'];
18
19 % Step4 : Finding Median using Mathematical formula
20 length_x = length(Pocket_Money);
21 i = 1;
22 while i < length_x
23     if Median_Term < Table(i,3)
24         Median = Table(i,1);
25         i = length_x + 1 ;
26     else
27         i = i + 1 ;
28     end
29 end
30 fprintf('Median is %f', Median)
31

```

**Pocket\_Money =** 1x5  
20 50 75 90 100

**Frequency =** 1x5  
3 7 10 9 14

**CF =** 1x5  
3 10 20 29 43

**Median Term is** 22.000000

**Median is** 90.000000

**Matlab\_Skill\_Activity\_01\_performed\_by\_YASH\_GUPTA\_2019BTCS088**

**Frequency =** 1x5  
3 7 10 9 14

**CF =** 1x5  
3 10 20 29 43

**Median Term is** 22.000000

**Median is** 90.000000

**Student\_Marks =** 5x4 table

	Pocket Money	Freq	Cumm. Freq	Prod_Abs_Mean
1	20	3	3	210
2	50	7	10	280
3	75	10	20	150
4	90	9	29	0
5	100	14	43	140

**Value of Mean Deviation (using mathematical formula approach) is** 18.139535

## E. Example 3: Mean Deviation about Median for Continuous Series

MATLAB Live Editor window showing code and results for Mean Deviation about Median for Continuous Series.

```

% MATLAB
% https://matlab.mathworks.com

% MATLAB Drive: / / MATLAB Drive / Test.mlx / Tests.mlx / 2019BTCS088_YG_Skill_03_Activity.mlx / Practical_05_YashGupta_2019BTCS088.mlx

% Matlab_Skill_Activity_01_performed_by_YASH_GUPTA_2019BTCS088
% Write MATLAB code for finding Mean Deviation about the Median for all 3 types of Series

Question: Marks of 5 students (out of 25) are given
Class : [0-5 5-10 10-15 15-20 20-25] ; Frequency : [6, 4, 3, 7, 10]

clc; clear all
% Solution:
% Given Marks of 5 Students are given
% Class : [0-5 5-10 10-15 15-20 20-25]
% Frequency : [6, 4, 3, 7, 10]
% Frequency = cumsum(Frequency)
% Continuous Exclusive Series

% Step 1: Finding the Cumulative Frequency
Marks = [2.5, 7.5, 12.5, 17.5, 22.5]
Frequency = [6, 4, 3, 7, 10]
CF = cumsum(Frequency)

% Step 2: Finding the Median Term
Median_Term = sum(Frequency)/2;
% As Median Term = 15;

% Step3 : Finding Median Class Interval
% Hence, Median Class -> 15-20
Lower_Limit = 15; upper_cf = 13; f = 7; Interval = 5;

% Step4 : Finding Median using Mathematical formula i.e.
% Median = Lower_limit + (((Median_Term) - upper_cf) / f)*Interval
Median = Lower_Limit + (((Median_Term) - upper_cf) / f)*Interval

% Step5: Finding Absolute Deviation about Mean
Abs_Mean = abs(Marks - Median);

% Step6: Product of Frequency & Absolute Mean
Prod_Abs_Mean = (Frequency).*(Abs_Mean);

% Step7: Finding sum of Absolute Deviation about Mean
Sum_Abs_Mean = sum(Prod_Abs_Mean);

% Tabular View
Student_Marks = table(Marks', Frequency', Abs_Mean', Prod_Abs_Mean');
Student_Marks.Properties.VariableNames = { 'Marks', 'Frequency', 'Abs_Mean', 'Prod_Abs_Mean' }

% Method : Via using traditional mathematical formula finding Mean Deviation about Mean
% Mean Deviation = (sum(|X - mean(X)|))/length(X)
Mean_Deviation = (Sum_Abs_Mean)./(sum(Frequency));
fprintf('Value of Mean Deviation (using mathematical formula approach) is %f', Mean_Deviation)

```

Output:

```

Marks = 1x5
2.5000 7.5000 12.5000 17.5000 22.5000
Frequency = 1x5
6 4 3 7 10
CF = 1x5
6 10 13 20 30

Median = 16.4286

Student_Marks = 5x4 table

```

	Marks	Frequency	Abs_Mean	Prod_Abs_Mean
1	2.5000	6	13.9286	83.5714
2	7.5000	4	8.9286	35.7143
3	12.5000	3	3.9286	11.7857
4	17.5000	7	1.0714	7.5000
5	22.5000	10	6.0714	60.7143

Value of Mean Deviation (using mathematical formula approach) is 6.642857

## F. Example 1: Mean Deviation from Mode for Individual Series

MATLAB Live Editor window showing code and results for Mean Deviation from Mode for Individual Series.

```

% MATLAB
% https://matlab.mathworks.com

% MATLAB Drive: / / MATLAB Drive / Test.mlx / Tests.mlx / 2019BTCS088_YG_Skill_Activity_01.mlx / Practical_05_YashGupta_2019BTCS088.mlx

% Matlab_Skill_Activity_01_performed_by_YASH_GUPTA_2019BTCS088
% Write MATLAB code for finding Mean Deviation about the Mode for all 3 types of Series

Question: Pocket money of 5 kids(in $ monthly basis) are given
Money : [20, 50, 100, 80, 10, 20, 90, 75, 25, 20]

clc; clear all
% Solution:
% Given : Pocket Money of 10 kids is given
% Pocket_Money : [20, 50, 100, 80, 10, 20, 90, 75, 25, 20]
% Individual Series

% Step 1: Storing the X in a variable Pocket_Money
Pocket_Money = [20, 50, 100, 80, 10, 20, 90, 75, 25, 20]
% Unimodal Series

% Step2 : Finding the mode using mode()
Mode = mode(Pocket_Money);
fprintf('Mode is %f', Mode)

% Step4: Finding Absolute Deviation about Mean
Abs_Mean = abs(Pocket_Money - Mode);

% Step6: Finding sum of Absolute Deviation about Mode
Sum_Abs_Mean = sum(Abs_Mean);

% Tabular View
Money = table(Pocket_Money', Abs_Mean');
Money.Properties.VariableNames = { 'Pocket Money', 'Absolute Mean' }

% Method : Via using traditional mathematical formula finding Mean Deviation about Mode
% Mean Deviation = (sum(|X - mode(X)|))/length(X)
Mean_Deviation = (Sum_Abs_Mean)./(length(Pocket_Money));
fprintf('Value of Mean Deviation (using mathematical formula approach) is %f', Mean_Deviation)

```

Output:

```

Pocket_Money = 1x10
20 50 100 80 10 20 90 75 25 20

Mode = 20.000000
Sum_Abs_Mean = 310
Money = 10x2 table

```

	Pocket Money	Absolute Mean
1	20	0
2	50	30
3	100	80
4	80	60
5	10	10
6	20	0
7	90	70
8	75	55
9	25	5

Value of Mean Deviation (using mathematical formula approach) is 31.000000

## G. Example 2: Mean Deviation from Mode for Discrete Series

Matlab\_Skill\_Activity\_01\_performed\_by\_YASH\_GUPTA\_2019BTCS088

**Write MATLAB code for finding Mean Deviation about the Mode for all 3 types of Series**

Question: Wages of 5 workers(in \$ daily basis) are given  
Wages = [15, 25, 35, 55, 65] Frequency : [6, 4, 3, 7, 10]

```

clc; clear all;
% Solution:
% Given : Wages of 5 workers(in $ daily basis) are given
% Wages = [15, 25, 35, 55, 65] % Discrete Series
% Frequency : [6, 4, 3, 7, 10]

% Step 1: Storing the X in a variable Pocket_Money & corresponding frequency
Wages = [15, 25, 35, 55, 65];
Frequency = [6, 4, 3, 7, 10];

% Step2 : Concatenating Wages-Frequency Array
WF = [15 6 ; 25 4 ; 35 3 ; 55 7 ; 65 10];

% Step3 : Finding Mode by finding highest frequency
Mode = WF(:,2) == max(WF(:,2)), 1);
fprintf('Mode is %f', Mode);

% Step4: Finding Absolute Deviation about Mode
Abs_Mean = abs(Wages - Mode);

% Step5 : Finding sum of Absolute Deviation about Mode
Sum_Abs_Mean = sum(Abs_Mean);

% Tabular View
Worker_Wages = table(Wages', 'Frequency', Abs_Mean');
Worker_Wages.Properties.VariableNames = { 'Wages' , 'Frequency' , 'Absolute Mean' };

% Method : Via using traditional mathematical formula finding Mean Deviation about Mode
% Mean Deviation = (sum(|X - median(X)|))/length(X)
Mean_Deviation = (Sum_Abs_Mean)/(sum(Frequency));
fprintf('Value of Mean Deviation (using mathematical formula approach) is %f', Mean_Deviation)

```

Wages = 1x5  
15 25 35 55 65

Frequency = 1x5  
6 4 3 7 10

Mode is 65.00000

Worker\_Wages = 5x3 table

	Wages	Frequency	Absolute Mean
1	15	6	50
2	25	4	40
3	35	3	30
4	55	7	10
5	65	10	0

Value of Mean Deviation (using mathematical formula approach) is 4.333333

## H. Example 3: Mean Deviation from Mode for Continuous Series

Matlab\_Skill\_Activity\_01\_performed\_by\_YASH\_GUPTA\_2019BTCS088

**Write MATLAB code for finding Mean Deviation about the Mode for all 3 types of Series**

Question: Salaries of 6 employees(in thousand) are given  
Exclusive\_Class : [20-25 25-30 30-35 35-40 40-45 45-50] ; Frequency : [6, 4, 3, 7, 10, 5]

```

clc; clear all;
% Solution:
% Given : Salaries of 6 employees(in $ thousand) are given
% Exclusive Class : [20-25 25-30 30-35 35-40 40-45 45-50] % Continuous Exclusive Series
% Frequency : [6, 4, 3, 7, 10, 5]

% Step 1: Finding the Mid-Value from Class Interval
Salaries = [22.5, 27.5, 32.5, 37.5, 42.5, 47.5];
Frequency = [6, 4, 3, 7, 10, 5];

% Step2 : Concatenating the Salaries & Frequency Array in order to find Modal Class
SF = [22.5 6 ; 27.5 4 ; 32.5 3 ; 37.5 7 ; 42.5 10 ; 47.5 5];

% Step3 : Finding Modal Class by finding highest frequency
Modal_Class = SF(:,2) == max(SF(:,2)), 1);
fprintf('Highest Frequency is CF %d', Modal_Class);
fprintf('Hence, Modal Class is %d-%d', Modal_Class);

% Using below mathematical formula for finding mode
Mode = L + ((f1 - f0)/(2*f1 - f0 - f2)).*h
L = 40; % Lower limit of modal class
f0 = 6; % Frequency of pre-modal class
f1 = 10; % Frequency of modal class
f2 = 5; % Frequency of post-modal class
h = 5; % Interval -> Difference between any 2 consecutive values of x (25-20 = 5)
;

% Step4 : Finding Mode using Mathematical Formula
Mode = L + ((f1 - f0)/(2*f1 - f0 - f2)).*h

% Step5: Finding Absolute Deviation about Mode
Abs_Mean = abs(Salaries - Mode);

% Step6 : Finding sum of Absolute Deviation about Mode
Sum_Abs_Mean = sum(Abs_Mean);

% Tabular View
Worker_Wages = table(Salaries', 'Frequency', Abs_Mean');
Worker_Wages.Properties.VariableNames = { 'Wages' , 'Frequency' , 'Absolute Mean' };

% Method : Via using traditional mathematical formula finding Mean Deviation about Mode
% Mean Deviation = (sum(|X - median(X)|))/length(X)
Mean_Deviation = (Sum_Abs_Mean)/(sum(Frequency));
fprintf('Value of Mean Deviation (using mathematical formula approach) is %f', Mean_Deviation)

```

Salaries = 1x6  
22.5000 27.5000 32.5000 37.5000 42.5000 47.5000

Frequency = 1x6  
6 4 3 7 10 5

SF = 6x2  
22.5000 6.0000  
27.5000 4.0000  
32.5000 3.0000  
37.5000 7.0000  
42.5000 10.0000  
47.5000 5.0000

Highest Frequency is of 42.500000  
Hence, Modal Class is 40-45

Mode = 41.8750

Worker\_Wages = 6x3 table

	Wages	Frequency	Absolute Mean
1	22.5000	6	18.3750
2	27.5000	4	14.3750
3	32.5000	3	9.3750
4	37.5000	7	4.3750
5	42.5000	10	0.6250
6	47.5000	5	5.6250

Value of Mean Deviation (using mathematical formula approach) is 1.938714

## SKILL ACTIVITY NO: 2

(Standard Deviation for all 3 types of Series)

Date: 17<sup>th</sup> June 2021

### SKILL ACTIVITY\_02

Date: 17-June 2021

Title: Standard Deviation for all 3 types of Series

1. What is the purpose of this activity? (Explain in 3-4 lines)

Ans: Purpose of this activity is to find out:-

① What is Standard Deviation?

② Why we need Standard Deviation as we have central tendency values i.e. (Mean, Mode & Median)

③ How: Standard deviation is calculated for 3 different types of series

→ Individual Series  
→ Discrete → " "  
→ Continuous → "

2. Steps performed in this Activity. (Explain in 5-6 lines)

Ans: ① For finding Standard Deviation of Individual Series

Step ① Take the mean of the "x" via using mean() in MATLAB

1/ By Traditional approach (Actual Mean Method) Step ② Subtract the Mean from x & store in variable.

Step ③ Use above variable to square it.

Step ④ Then simply use the formula:  $s = \sqrt{\frac{\sum(x-\bar{x})^2}{N}}$

$$SD(s) = \sqrt{\frac{\sum(x-\bar{x})^2}{N}}$$

⑤ equals

II Methods Step ① Directly use the std() function of MATLAB to find standard Deviation. In argument of std() provide your x, {series}

② For finding Standard Deviation of Discrete Series

Step ① Here, we have Discrete values i.e. x & freq

② Find out if the difference b/w "x" values are equal or not  
if NOT EQUAL → Then we gonna use Assumed Mean Deviation Method  
for finding Standard Deviation. (S.D(x))

Step ③ Find out  $\sum freq$  → & store in N.

Step ④ Then, Assume mean from yourself → & store in a var.

- Step⑤: Subtract the Assumed mean from  $\bar{x}$  & store in var.  $D$
- Step⑥: Then square the var. ( $D$ ) above & store in New var.
- Step⑦: Find out the value of  $(\sum f \cdot D^2)$  &  $(\sum f \cdot D)$  using the  $D$ 's var
- Step⑧: After all, apply the formula of Assumed Mean for finding Standard Deviation.

$$\sigma = \sqrt{\frac{\sum f \cdot D^2}{N} - \frac{(\sum f \cdot D)^2}{N}}$$

### ③ For finding Standard Deviation of Continuous Exclusive Series:

- Step①: Here, we have given Classes & their respective frequencies.  
So first we take out the (MIDDLE-) value of the classes & store in the var  $\bar{x}$  (Mark's salary)

Step②: Calculate the value of  $N \rightarrow (\sum f)$ ,  $h$  (Interval diff. b/w  $\bar{x}$ )

Step③: Here, we have to use Step Deviation method

$$\sigma = \sqrt{\left( \frac{\sum f D^2}{N} - \frac{(\sum f \cdot D)^2}{N} \right) * h}$$

Step④: Find the Mean  $\rightarrow$  {via Assumed mean}

Step⑤: Find the value of  $D = \frac{\bar{x} - \text{Mean}}{h}$

Step⑥: Square the value of  $D$  & store in particular var.

Step⑦: After all above steps, apply the Step Deviation Method for finding Standard Deviation.

$$\sigma = \sqrt{\left( \frac{\sum f D^2}{N} - \frac{(\sum f \cdot D)^2}{N} \right) * h}$$

3. What Resources/ Materials/Equipment's/tools did you use for this activity?

- Ans: ① MATLAB 30-day trial software  
② Standard Deviation CheatSheet

4. What skills did you acquire?

- Get to know about what is Standard Deviation?
- why we Need Standard Deviation?
- How to use MATLAB coding for Standard Deviation?
- ↳ Use of std() function, Matrix multiplication, Matrix Division)
- ↳ Use of Table( ) in MATLAB.

5. Time taken to complete this activity? 03:00 (hours)

  
Signature of Students

## (To be filled by Faculty)

Sr. No.	Skill /Competencies	(Achieved / Not Achieved) (Yes / No)

Remarks :

Total mark \_\_\_\_\_ out of 10.

Signature of Faculty

Date: \_\_\_\_\_

## Details of the Activity

### A. Example 1: Standard Deviation for Individual Series.

The screenshot shows the MATLAB Live Editor interface. On the left, the code for finding the standard deviation of marks for five students is displayed:

```
% Matlab_Skill_02_performed_by_YASH_GUPTA_2019B1CS088
% -----
% Write MATLAB code for finding Standard Deviation of Individual Series
% Question 01: Marks of 5 students are given
% Marks : [10, 12, 13, 15, 20]
% Find out the Standard Deviation.

% Solution:
% Given : Marks of 5 students as Individual Series
Marks = [10, 12, 13, 15, 20]

Mean = mean(Marks)
Marks1 = Marks-Mean
MarksSq = (Marks1.^2)

% Tabular View
Student_Marks = table(Marks', Marks1', MarksSq');
Student_Marks.Properties.VariableNames= {'Marks' 'Marks-Mean' 'Marks1.^2'};

% Method_01: Via using std() function of MATLAB
StandDevMarks_01 = std(Marks);
fprintf('Standard Deviation of Marks (using std()) is %f' , StandDevMarks_01)

% Method_02: Via using traditional Way for finding Standard Deviation
StandDevMarks_02 = ((sum(MarksSq)./length(Marks)).^(1/2));
fprintf('Standard Deviation of Marks (via traditional way) is %f' , StandDevMarks_02)
```

On the right, the results are displayed in a table:

	Marks	Marks-Mean	Marks1.^2
1	10	-4	16
2	12	-2	4
3	13	-1	1
4	15	1	1
5	20	6	36

Below the table, two standard deviation values are printed:

Standard Deviation of Marks (using std()) is 3.887887  
Standard Deviation of Marks (via traditional way) is 3.405877

### B. Example 2: Standard Deviation for Individual Series.

The screenshot shows the MATLAB Live Editor interface. On the left, the code for finding the standard deviation of wages for five workers is displayed:

```
% Question_02: Wages of 5 workers are given
% Marks : [550, 250, 150, 350, 400]
% Find out the Standard Deviation.

% Solution:
% Given : Wages of 5 workers as Individual Series
Wages = [550, 250, 150, 350, 400]

Mean = mean(Wages);
Wages_A = Wages-Mean;
WagesSq = (Wages_A).^2;

% Tabular View
Worker_Wages = table(Wages', Wages_A', WagesSq');
Worker_Wages.Properties.VariableNames= {'Wages' 'Wages_A' 'WagesSq'};

% Method_01: Via using std() function of MATLAB
StandDevWages_01 = std(Wages);
fprintf('Standard Deviation of Wages (using std()) is %f' , StandDevWages_01)

% Method_02: Via using traditional Way for finding Standard Deviation
StandDevWages_02 = ((sum(WagesSq)./length(Wages)).^(1/2));
fprintf('Standard Deviation of Wages (via traditional way) is %f' , StandDevWages_02)
```

On the right, the results are displayed in a table:

	Wages	Wages...	Wages...
1	550	210	44100
2	250	-90	8100
3	150	-190	36100
4	350	10	100
5	400	60	3600

Below the table, two standard deviation values are printed:

Standard Deviation of Wages (using std()) is 151.657509  
Standard Deviation of Wages (via traditional way) is 135.646600

### C. Example 3: Standard Deviation for Individual Series.

The screenshot shows the MATLAB Live Editor interface. The code in the editor calculates the standard deviation of sales for 5 products. It first finds the mean and then calculates the standard deviation using both the `std` function and a traditional formula. The results are displayed in the workspace and command window.

```

% Question_03: Sales of 5 products(sold pieces quantity) are given
% Sales : [20, 25, 30, 45, 15]
% Find out the Standard Deviation.

% Solution:
% Given : Sales of 5 products is given as Individual Series

Quantity = [20, 25, 30, 45, 15]

Mean = mean(Quantity);
Quantity_A = Quantity-Mean;
QuantitySq = (Quantity_A).^2;

% Tabular View

Product_Sales = table(Quantity', Quantity_A', QuantitySq');
Product_Sales.Properties.VariableNames= {'Quantity' 'Quantity_A' 'QuantitySq'};

% Method 01: Via using std() function of MATLAB
StanDevSales_01 = std(Quantity);
fprintf('Standard Deviation of Sales of products (using std()) is %f', StanDevSales_01)

% Method 02: Via using traditional Way for finding Standard Deviation
StanDevSales_02 = ((sum(QuantitySq)./length(Quantity)).^(1/2));
fprintf('Standard Deviation of Sales of products (via traditional way) is %f', StanDevSales_02)

```

**Quantity** = 1×5  
20 25 30 45 15

**Product\_Sales** = 5×3 table

	Quantity	Quantity_A	QuantitySq
1	20	-7	49
2	25	-2	4
3	30	3	9
4	45	18	324
5	15	-12	144

Standard Deviation of Sales of products (using std()) is 11.510864

Standard Deviation of Sales of products (via traditional way) is 10.295639

### D. Example 1: Standard Deviation for Discrete Series.

The screenshot shows the MATLAB Live Editor interface. The code calculates the standard deviation of marks for 5 students. It first finds the assumed mean and then calculates the standard deviation using the assumed mean method. The results are displayed in the workspace and command window.

```

% Matlab.Skill_02_performed_by_YASH_GUPTA_2019BTCS088
% -----
%
% Write MATLAB code for finding Standard Deviation of Discrete Series

% Question_01: Marks of 5 students are given
% Marks : [1, 3, 5, 7, 8]
% Freq : [1, 2, 3, 4, 5]
% Find out the Standard Deviation.

% Solution:
% Given : Marks of 5 students as Discrete Series
Marks = [1, 3, 5, 7, 8];
Freq_03 = [1, 2, 3, 4, 5];

% Sum of frequency
N = sum(Freq_03);

% We will take Assumed Mean for Marks(X)
Mean_01 = 5;
D1 = Marks-Mean_01;
MarksSq = (D1).^2;
FreqD = (Freq_03).*(D1);
FreqD2 = (Freq_03).*(D1.*01);

% Tabular View
Student_Marks = table(Marks', Freq_03', D1', FreqD', FreqD2');
Student_Marks.Properties.VariableNames= {'Marks' 'Freq' 'Marks-Mean' 'FreqD' 'FreqD2'};

% Method: Via Assumed Mean Method because (Marks != have Same Interval)
% for finding Standard Deviation
StandevMarks_01 = (sum(FreqD2)./N - (sum(FreqD)./N).^2).^(1/2);
fprintf('Standard Deviation of Marks (via traditional way) is %f', StanDevMarks_01)

```

**Marks** = 1×5  
1 3 5 7 8

**Freq\_03** = 1×5  
1 2 3 4 5

**Student\_Marks** = 5×5 table

	Marks	Freq	Marks-Mean	FreqD	FreqD2
1	1	1	-4	-4	16
2	3	2	-2	-4	8
3	5	3	0	0	0
4	7	4	2	8	16
5	8	5	3	15	45

Standard Deviation of Marks (via traditional way) is 2.166247

#### **E. Example 2: Standard Deviation for Discrete Series.**

The screenshot shows the MATLAB Live Editor interface. The left pane displays a script named 'Skill\_02\_YG\_2019BTCS088.mlx' containing MATLAB code for calculating wages and their standard deviation. The right pane shows the results of the execution.

```
% Question_02: Wages of 5 workers are given
% Marks : [550, 250, 150, 350, 400]
% Freq : [3, 7, 4, 9, 10]
% Find out the Standard Deviation.

% Solution:
% Given : Wages of 5 workers as Discrete Series

Wages = [550, 250, 100, 350, 400]
Freq_02 = [3, 7, 4, 9, 10]

% We will take Assumed Mean for Marks(X)
Mean_02 = 350;
D2 = Wages-Mean_02;
WagesSq = (D2).^2;
FreqD3 = (Freq_02).*(D2);
FreqD4 = (Freq_02).*(D2.^2);

% Sum of frequency
N1 = sum(Freq_02);

% Tabular View

Worker_Wages = table(Wages', Freq_02', D2', FreqD3', FreqD4');
Worker_Wages.Properties.VariableNames= {'Wages' 'Freq_02' 'Wages-Mean' 'FreqD3' 'FreqD4'}

% Method: Via Assumed Mean Method because (Wages != have Same Interval)
% for finding Standard Deviation
StanDevWages_01 = (sum(FreqD4)./N1 - (sum(FreqD3)./N1).^2).^(1/2);
fprintf(' Standard Deviation of Wages (via traditional way) is %f', StanDevWages_01)
```

The results pane shows the following output:

```
Wages = 1x5
550 250 100 350 400
Freq_02 = 1x5
3 7 4 9 10
```

	Wages	Freq_02	Wages-Mean	FreqD3	FreqD4
1	550	3	200	600	120000
2	250	7	-100	-700	70000
3	100	4	-250	-1000	250000
4	350	9	0	0	0
5	400	10	50	500	25000

Standard Deviation of Wages (via traditional way) is 117.304435

#### **F. Example 3: Standard Deviation for Discrete Series.**

WORKSPACE

```
57  
58  
59  
60  
61  
62  
63  
64 % Question_03: Salaries of 5 employees(in thousands) are given  
65 % Sales : [20, 25, 30, 45, 15]  
66 % Freq : [3 , 5, 8, 7, 4]  
67 % Find out the Standard Deviation.  
68  
69  
70 % Solution:  
71 % Given : Sales of 5 products is given as Discrete Series  
72 Salaries = [20, 25, 30, 45, 15]  
73 Freq_03 = [3 , 5, 8, 7, 4]  
74  
75 % Sum of frequency  
76 N2 = sum(Freq_03);  
77  
78 h = 5; % Interval = Difference between any 2 consecutive values of X  
79 Mean_03 = 25; % Assumed Mean  
80  
81 D3 = (Salaries-Mean_03)./h  
82 SalariesSq = (D3).^2;  
83 FreqD5 = (Freq_02).*(D3);  
84 FreqD6 = (Freq_02).*((D3.*D3));  
85  
86 % Tabular View  
87 Employee_Salary = table(Salaries' , Freq_03' , D3' , FreqD5' , FreqD6');  
88 Employee_Salary.Properties.VariableNames= { 'Salaries' 'Freq_03' '(Salaries-Mean_03)./h' 'FreqD5' 'FreqD6'}  
89  
90 % Method: Via Step Deviation Method because (Salaries = have Same Interval)  
91 % for finding Standard Deviation  
92 StanDevSalaries_01 = ((sum(FreqD6)./N2 - (sum(FreqD5)./N2).^2).^(1/2)).*(h);  
93 fprintf('Standard Deviation for Salaries of employees (via traditional way) is %f' , StanDevSalaries_01)  
94
```

Salaries = 1x5  
20 25 30 45 15

Freq\_03 = 1x5  
3 5 8 7 4

D3 = 1x5  
-1 0 1 4 -2

Employee\_Salary = 5x5 table

	Salaries	Freq_03	(Salaries-Mean_03)./h	FreqD5	FreqD6
1	20	3	-1	-3	3
2	25	5	0	0	0
3	30	8	1	4	4
4	45	7	4	36	144
5	15	4	-2	-20	40

Standard Deviation for Salaries of employees (via traditional way) is 12.92856

### **G. Example 1: Standard Deviation for Continuous Series.**

The screenshot shows the MATLAB R2019b interface with a red box highlighting the code area and another red box highlighting the output window.

**Code Area:**

```
% Matlab_SKILL_02_performed_by_YASH_GUPTA_2019BTECS088
%
% Write MATLAB code for finding Standard Deviation of Continuous Series

% Question 01: Marks of 5 students are given
% Class : [0-5 5-10 10-15 15-20 20-25]
% Freq : [1, 2, 3, 4, 5]
% Find out the Standard Deviation.

% Solution:
% Given : Marks of 5 students as Continuous Exclusive Series
% Class : [0-5 5-10 10-15 15-20 20-25]
Marks = [2.5, 7.5, 12.5, 17.5, 22.5] % Taking MID-VALUE from Class
Freq_01 = [1, 2, 3, 4, 5]

% Sum of frequency
N = sum(Freq_01);
h1 = 5; % Interval = Difference between any 2 consecutive values of X {7.5-2.5= 12.5-7.5}

% We will take Assumed Mean for Marks(X)
Mean = 12.5;
D1 = (Marks-Mean)../h1;
MarksSq = (D1).^2;
FreqG = (Freq_01).*(D1);
FreqD2 = (Freq_01).*.(D1.*D1);

% Tabular View
Student_Marks = table(Marks', Freq_01', D1', FreqD', FreqD2');
Student_Marks.Properties.VariableNames = {'Marks' 'Freq' 'Marks-Mean' 'FreqD' 'FreqD2'};

% Method: Via Step Deviation Method for finding Standard Deviation
StdDevMarks_01 = ((sum(FreqD2)./N - (sum(FreqD)./N).*2).^(1/2)).*(h1);
fprintf('Standard Deviation of Marks (via traditional way) is %f', StdDevMarks_01)
```

**Output Window:**

```
Marks = 1×5
    2.5000    7.5000   12.5000   17.5000   22.5000

Freq_01 = 1×5
    1         2         3         4         5

Student_Marks = 5×5 table
```

	Marks	Freq	Marks-Mean	FreqD	FreqD2
1	2.5000	1	-2	-2	4
2	7.5000	2	-1	-2	2
3	12.5000	3	0	0	0
4	17.5000	4	1	4	4
5	22.5000	5	2	10	20

Standard Deviation of Marks (via traditional way) is 6.236096

#### **H. Example 2: Standard Deviation for Continuous Series.**

The screenshot shows the MATLAB Live Editor interface with a red box highlighting the code area. The code calculates the standard deviation of wages for five workers using the traditional method. The results are displayed in two tables: 'Wages' and 'Worker\_Wages'. The 'Wages' table shows the frequency distribution, and the 'Worker\_Wages' table shows the calculated statistics.

```
% Question_02: Wages of 5 workers are given
% Class : [0-10 10-20 20-30 30-40 40-50 50-60 60-70 70-80]
% Freq = [3, 7, 4, 9, 10]
% Find out the Standard Deviation.

% Solution:
% Given : Wages of 5 workers as Continuous Exclusive Series

Wages = [5, 15, 25, 35, 45, 55, 65, 75] % Taking MID-VALUE from Class
Freq_02 = [15, 23, 22, 25, 10, 5, 10]

% Sum of frequency
N1 = sum(Freq_02);
h2 = 10; % Interval = Difference between any 2 consecutive values of X (15-5=10)
% We will take Assumed Mean for Wages(X)
Mean_02 = 35;
D2 = (Wages-Mean_02)./h2;
WagesSq = (D2).^2;
FreqD03 = (Freq_02).*(D2);
FreqD04 = (Freq_02).*(D2.^2);

% Tabular View
Worker_Wages = table(Wages', Freq_02', D2', FreqD03', FreqD04');
Worker_Wages.Properties.VariableNames= {'Wages' 'Freq_02' 'Wages-Mean' 'FreqD03' 'FreqD04'};

% Method: Via Assumed Mean Method because (Wages != have Same Interval)
% For finding Standard Deviation
StdDevWages_01 = ((sum(FreqD04)./N1 - (sum(FreqD03)./N1).^2).^(1/2));
printf('Standard Deviation of Wages (via traditional way) is %f ', StdDevWages_01)
```

	5	15	25	35	45	55	65	75
Freq_02	15	23	22	25	10	5	10	

	Wages	Freq_02	Wages-Mean	FreqD03	FreqD04
1	5	15	-3	-45	135
2	15	23	-2	-30	60
3	25	22	-1	-23	23
4	35	25	0	0	0
5	45	10	2	20	40
6	55	5	3	15	45
7	65	4			
8	75	10			

Standard Deviation of Wages (via traditional way) is 19.757895

## I. Example 3: Standard Deviation for Continuous Series.

The screenshot shows the MATLAB Live Editor interface. The code in the editor is as follows:

```
% Solution:  
% Given : Marks of 5 students as Continuous Exclusive Series  
  
% Question_03: Salaries of 4 employees(in thousands) are given  
% Class: [26-25 25-30 30-35 35-40]  
% Freq:[3 , 5, 8, 7]  
% Find out the Standard Deviation.  
  
% Solution:  
% Given : Salaries of 4 employees is given as Continuous Exclusive Series  
% Salaries = [22.5, 27.5, 32.5, 37.5] % Taking MID-VALUE from Class  
Salaries = [22.5, 27.5, 32.5, 37.5]  
Freq_03 = [3 , 5, 8, 7]  
  
% Sum of frequency  
N2 = sum(Freq_03);  
h3 = 6; % Interval = Difference between any 2 consecutive values of X  
  
Mean_03 = 27.5; % Assume Mean for Salaries  
D3 = (Salaries-Mean_03).^2;  
Salaries.^2  
FreqD5 = (Freq_03).^2;  
FreqD6 = (Freq_03).^(D3.^2);  
  
% Tabular View  
Employee_Salary = table(Salaries', Freq_03', D3', FreqD5', FreqD6');  
Employee_Salary.Properties.VariableNames = {'Salaries' 'Freq_03' '(Salaries-Mean_03)^2' 'FreqD5' 'FreqD6'}  
  
% Method: Via Step Deviation Method because (Salaries = have Same Interval)  
% for finding Standard Deviation  
StandDevSalaries_01 = ((sum(FreqD6)./N2 - (sum(FreqD5)./N2).^2).^(1/2)).*(h3);  
fprintf('Standard Deviation for Salaries of employees (via traditional way) is %f', StandDevSalaries_01)
```

The output window displays the following results:

```
Salaries = 1x4  
22.5000 27.5000 32.5000 37.5000  
Freq_03 = 1x4  
3 5 8 7  
  
Employee_Salary = 4x5 table  
Salaries Freq_03 (Salaries-Mean_03)^2 FreqD5 FreqD6  
1 22.5000 3 1 -3 3  
2 27.5000 5 0 0 0  
3 32.5000 8 1 8 8  
4 37.5000 7 2 14 28
```

Standard Deviation for Salaries of employees (via traditional way) is 5.032973

# SKILL ACTIVITY NO: 3

## (Application of Correlation using the MATLAB)

Date: 17<sup>th</sup> June 2021

### SKILL ACTIVITY-03

Date: 17<sup>th</sup> June 2021

Title: Application of Correlation using MATLAB

1. What is the purpose of this activity? (Explain in 3-4 lines)

Purpose of this activity is to find out:-

- ① What is Correlation?; why we require Correlation?
- ② Need of correlation in Real world problems.
- ③ 3 values of correlation & their respective graphs
- ④ What do we mean by Correlation coefficient?

2. Steps performed in this Activity. (Explain in 5-6 lines)

To find out correlation in MATLAB we have two ways,

- ① → via using pre-created function 'corrcoef()'
- ② → via using mathematical formula i.e.

$$\text{Correlation } (r_{xy}) = \frac{n \sum(x \cdot y) - \sum x \cdot \sum y}{(\sqrt{n \sum x^2 - (\sum x)^2})(\sqrt{n \sum y^2 - (\sum y)^2})}$$

Method 1:  
//MATLAB Function

So for finding correlation via using corrcoef()

Then simply provide the x & y as Argument to corrcoef(x, y) function.

Method 2: Via Traditional Mathematical formula we have to perform certain steps.

Step①: Obtain a data sample with the values of x-variable & y-variable & store them in an array.

Step②: Calculate the sum of 'x' variable, 'y' variable using sum() of matlab

Step③: Now, according to mathematical formula, same we have to multiply the variable's with as mentioned in the above formula.

Step④: After that, find the square root of the value obtained by squaring the each value & calculating the sum of the Result.

Step⑤: Divide the value obtained in Step④ by the value obtained in Step③.

Method 3: In order to calculate "the correlation using the below formula, we have to perform following steps:

Step 1: Obtain 'a data sample with the values of x-variable & y-variable

Step 2: Calculate the means (average)  $\bar{x}$  for the x-variable &  $\bar{y}$  for the y-variable

Step 3: For the x-variable, subtract the mean from each value of the x-variable (let's call) this new variable 'MN\_Sp10'. Do the same for the y-variable (let's call this variable 'MN\_Apple')

Step 4: Multiply each a-value by the corresponding b-value & find the sum of these multiplications (the final value is the Numerator in the formula)

Step 5: Square each a-value & calculate the sum of the result.

Step 6: Find the square root of the value obtained in the previous step (this is the denominator in the formula)

Step 7: Divide the value obtained in Step 4 by the value obtained in Step 6

Formula we used:

$$r_{xy} = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum (x_i - \bar{x})^2 \sum (y_i - \bar{y})^2}}$$

$x_i$  → Denotes the values of the x & y-variable in sample

$y_i$

$\bar{x}$  → 6 4 mean 4 n n n n 4  
 $\bar{y}$

$r_{xy}$  → The correlation coefficient of the linear relationship b/w variables 'x' & 'y'

3. What Resources/ Materials/ Equipment's/ tools did you use for this activity?

1. Matlab 30-Day Trial software (2021a)
2. Correlation Example from Web

4. What skills did you acquire?

- ↳ Get to know about what is correlation?
- ↳ why we need Correlation? (Applications of correlation mostly in machine learning/ Data Science)
- ↳ How to use MATLAB pre-defined functions() for finding correlation.
- ↳ Usage of corr(), corrcoef() function.
- Matrix multiplication, Division
- ↳ Use of Table() in MATLAB.

5. Time taken to complete this Activity? 03:00 (HOURS)

Yogesh  
Signature of Student

## (To be filled by Faculty)

Sr. No.	Skill /Competencies	(Achieved / Not Achieved) (Yes / No)

Remarks :

Total mark \_\_\_\_\_ out of 10.

Signature of Faculty

Date: \_\_\_\_\_

## Details of Activity:

### MATLAB CODE:

Matlab\_Skill\_Activity\_03\_performed\_by\_YASH\_GUPTA\_2019BTCS088

Write MATLAB code for Application of Correlation using MATLAB

Question: John is an investor. His portfolio primarily tracks the performance of the S&P 500 and John wants to add the stock of Apple Inc. Before adding Apple to his portfolio, he wants to assess the correlation between the stock and the S&P 500 to ensure that adding the stock won't increase the systematic risk of his portfolio.

```
1 cle ; clear all
2 % Solution:
3 % Given : Stock Price list for 5 consecutive years [2017 - 2021]
4 % Year : [2017, 2018, 2019, 2020, 2021]
5 % S&P 500(in $) : [1691.75 , 1977.80, 1884.09, 2151.13, 2519.36]
6 % Apple.Inc(in $) : [68.96, 100.11, 109.06, 112.18, 154.12]
7
8 Year = [2017, 2018, 2019, 2020, 2021]
9 SP_500 = [1691.75 , 1977.80, 1884.09, 2151.13, 2519.36]
10 Apple_Inc = [68.96, 100.11, 109.06, 112.18, 154.12]
11
12 % Tabular View
13 Correlation_Table = table(Year', SP_500', Apple_Inc');
14 Correlation_Table.Properties.VariableNames = { 'Year' , 'S&P_500' , 'Apple_Inc' }
15
16 % Method 1: Via using corr() and corrcoef() function of MATLAB
17 Correlation = corr(SP_500 , Apple_Inc)
18 Corr_01 = corrcoef(SP_500 , Apple_Inc)
19 fprintf('Value of Correlation coefficient (using mean approach) is %f' , Corr_01)
20
21 % -----
```

Correlation = 5x5

	Year	S&P_500	Apple_Inc
1	2017	1.6918e+03	68.9600
2	2018	1.9778e+03	100.1100
3	2019	1.8841e+03	109.0600
4	2020	2.1511e+03	112.1800
5	2021	2.5194e+03	154.1200

Correlation = 5x5

	NaN	NaN	NaN	NaN
NaN	NaN	NaN	NaN	NaN
NaN	NaN	NaN	NaN	NaN
NaN	NaN	NaN	NaN	NaN
NaN	NaN	NaN	NaN	NaN
NaN	NaN	NaN	NaN	NaN

Corr\_01 = 2x2

	1.0000	0.9547
1.0000	0.9547	1.0000

Value of Correlation coefficient (using mean approach) is 1.000000Value of Correlati

Test.mlx

Correlation\_Table = table(Year' , SP\_500' , Apple\_Inc');
Correlation\_Table.Properties.VariableNames = { 'Year' , 'S&P\_500' , 'Apple\_Inc' }

% Method 1: Via using corr() and corrcoef() function of MATLAB
Correlation = corr(SP\_500 , Apple\_Inc)
Corr\_01 = corrcoef(SP\_500 , Apple\_Inc)
fprintf('Value of Correlation coefficient (using mean approach) is %f' , Corr\_01)
%

% -----

% Method 2: Via using Traditional Mathematical Formula of correlation i.e.
% Correlation (r) = sum((x - x\_mean).\*(y - y\_mean))./(sum((x - x\_mean)^2).\*sum(y - y\_mean)^2))
n = length(SP\_500);
MN\_X = sum(SP\_500.\*Apple\_Inc);
MN\_Y = sum(SP\_500).\*sum(Apple\_Inc);
Numerator = n\*MN\_X - MN\_Y;
C = sum(SP\_500.^2);
D = sum(SP\_500)^2;
E = sum(Apple\_Inc.^2);
F = sum(Apple\_Inc).^2;
Denominator = (sqrt(n\*C-D))\*(sqrt(n\*E-F));
Corr\_02 = (Numerator/Denominator);
fprintf('Value of Correlation coefficient (using traditional approach) is %f' , Corr\_02)
%

% -----

% Method 3: Via using Mathematical Formula of correlation converting Mean i.e.
% Correlation (r) = sum((x - x\_mean).\*(y - y\_mean))./(sum((x - x\_mean)^2).\*sum((y - y\_mean)^2))
mean(SP\_500);
mean(Apple\_Inc);
a = SP\_500 - mean(SP\_500);
b = Apple\_Inc - mean(Apple\_Inc);
A2 =sum(a.\*a);
B2 = sum(b.\*b);
Corr\_03 = (sum(a.\*b))./((A2.\*B2).^(1/2));
fprintf('Value of Correlation coefficient (using mean approach) is %f' , Corr\_03)
%

Correlation = 5x5

	NaN	NaN	NaN	NaN
NaN	NaN	NaN	NaN	NaN
NaN	NaN	NaN	NaN	NaN
NaN	NaN	NaN	NaN	NaN
NaN	NaN	NaN	NaN	NaN

Corr\_01 = 2x2

	1.0000	0.9547
1.0000	0.9547	1.0000

Value of Correlation coefficient (using mean approach) is 1.000000Value of Correlati

Value of Correlation coefficient (using traditional approach) is 0.954705

Value of Correlation coefficient (using mean approach) is 0.954705

# SKILL ACTIVITY NO: 4

(Application of Curve-fitting for Real-World Problems via MATLAB)

Date: 25-June-2021

## SKILL ACTIVITY\_04

Date: 25<sup>th</sup> June 2021

TITLE: Application of ~~Test~~ CurveFitting for RealWorld Problems using MATLAB

1. What is the purpose of this Activity? (Explain in 3-4 lines)

Purpose of this activity is to find out:-

- ↳ (1) what is Curve-fitting? Why we need it?
- ↳ (2) Need of Curve-fitting in Realworld problems.
- ↳ (3) How to find Best ~~curve~~ fitted curve for any problem?
- ↳ (4) How to choose the degree of curve for different kind of problems?

2. Steps performed in this Activity. (Explain in 5-6 lines)

We have given some list of ~~abs~~ abscissas & coordinates  $(x_k, y_k)$  where  $k=0 \dots n$ . As 'x' takes values  $x_0, x_1, x_2, x_3, \dots, x_n$  then the corresponding values of y are  $y_0, y_1, y_2, y_3, \dots, y_n$ .

Our goal is to find a curve that is "BEST FITTED" in the data.

On the basis of degree of curve, we have

different types:

$$\text{Linear fit} \rightarrow g(x) = a + bx$$

$$\text{Parabolic fit} \rightarrow g(x) = a + bx + cx^2$$

$$\text{Cubic fit} \rightarrow g(x) = a + bx + cx^2 + dx^3$$

$$n^{th} \text{ fit} \rightarrow g(x) = a + bx + cx^2 + dx^3 + \dots$$

Now, in order to find the constants  $a, b, c, d, \dots$  etc. we have to apply some technique which minimizes the error i.e. all given data points are very close to the curve we are going to find. This technique is using Method of Least Squares!

① For Linear Fit  $\rightarrow g(x) = a + bx$

$$\begin{bmatrix} n & \sum x \\ \sum x & \sum x^2 \end{bmatrix} \begin{bmatrix} a \\ b \end{bmatrix} = \begin{bmatrix} \sum y \\ \sum xy \end{bmatrix}$$

② For Parabolic Fit  $\rightarrow g(x) = a + bx + cx^2$

$$\begin{bmatrix} n & \sum x & \sum x^2 \\ \sum x & \sum x^2 & \sum x^3 \\ \sum x^2 & \sum x^3 & \sum x^4 \end{bmatrix} \begin{bmatrix} a \\ b \\ c \end{bmatrix} = \begin{bmatrix} \sum y \\ \sum xy \\ \sum x^2y \end{bmatrix}$$

$$\textcircled{3} \text{ For Cubic Fit: } \rightarrow q(x) = a + bx + cx^2 + dx^3$$

$$\begin{bmatrix} 1 & \sum x & \sum x^2 & \sum x^3 \\ \sum x & \sum x^2 & \sum x^3 & \sum x^4 \\ \sum x^2 & \sum x^3 & \sum x^4 & \sum x^5 \\ \sum x^3 & \sum x^4 & \sum x^5 & \sum x^6 \end{bmatrix} \begin{bmatrix} a \\ b \\ c \\ d \end{bmatrix} = \begin{bmatrix} \sum y \\ \sum y^2 \\ \sum y^3 \\ \sum y^4 \end{bmatrix}$$

As mentioned above, we have to solve Realworld problem using Curve fitting - hence, we took a problem related to Mechanical characteristics of Bituminous  
Step①: Here, we have Strain-Amplitude as "x" and  
Complex-Modulus as "y"

Step②: we used the polyval() as well as polyfit() of MATLAB.  
polyval() → For evaluating the polynomial means it provides  
the value of constants.

Step③: polyfit() → For Least-Square polynomial curve fitting  
Provides Best Fitted Curve.  
plot() → For plotting the curve.

After writing code, we have changed the degree of polynomial  
manually in order to find the Fitted curve

↳ we changed from 1 → 2 → 3 → 5 → 10  
↳ found the most accurate line / best-fitted line!

3. What Resources/ Materials/ Equipment's/ Tools did you use for this activity?

1. Matlab 30-Days Trial Software (2021a)

2. plot(), polyval(), polyfit() from  
Matlab Help.

3. Data from NPTEL course i.e. Mechanical characterization  
of Bituminous.

4. What skills did you acquire?

↳ Get to know about what - why when to use curve fitting?

↳ Applications of curve-fitting

↳ How to use MATLAB pre-defined func for curve fitting

↳ Usage of plot(), polyval() & polyfit() in MATLAB

↳ Usage of plot(), polyval() & polyfit() in MATLAB

5. Time taken to complete this Activity? 03:00(HOURS)

Yugash

Signature of Student

## (To be filled by Faculty)

Sr. No.	Skill /Competencies	(Achieved / Not Achieved) (Yes / No)

Remarks :

Total mark \_\_\_\_\_ out of 10.

Signature of Faculty

Date: \_\_\_\_\_

## Details of Activity:

### MATLAB CODE:

Matlab\_Skill\_04\_performed\_by\_YASH\_GUPTA\_2019BTCS088  
Write MATLAB code for Application of Curve-Fitting by Least Square Method

Question: We are going to plot the best-fitted curve for Amplitude Sweep. It is between Complex Modulus of Bituminous Material & its corresponding Strain Amplitude. The values of Strain Amplitude ranges from 0.0167 to 1.000 with a difference of 0.12 while its corresponding the complex Modulus values are [-0.45, 0.447, 1.978, 3.28, 6.16, 7.34, 7.66, 9.56, 11.4] respectively.

```
% Solution:  
% Following data is given in question:-  
% Strain_Amplitude(X) = [ 0.0167:0.12:1.000 ] // X-axis  
% Complex_Modulus(Y) = [ -0.45 , 0.447, 1.978, 3.28, 6.16, 7.34, 7.66, 9.56, 11.4 ] // Y-axis  
clc; clear all; close all;  
  
Strain_Amplitude = [ 0.0167:0.12:1.000 ]  
Complex_Modulus = [ -0.45 , 0.447, 1.978, 3.28, 6.16, 7.34, 7.66, 9.56, 11.4 ]  
  
% Finding the value of 'a' & 'b' in y = ax + b;  
Plot_1Degree = polyfit(Strain_Amplitude, Complex_Modulus, 1) % 1 --> Represents the degree of curve  
  
% Plotting Linear Curve using plot()  
y_fit_1 = polyval(Plot_1Degree, Strain_Amplitude)  
plot(Strain_Amplitude, Complex_Modulus, 'ro', Strain_Amplitude, y_fit_1)  
xlabel('Strain Amplitude')  
ylabel('Complex Modulus')  
plot(Strain_Amplitude, Complex_Modulus, 'mo-', Strain_Amplitude, y_fit_1)  
xlabel('Strain Amplitude')  
ylabel('Complex Modulus')  
  
% Plotting Quadratic Curve using plot()  
y_fit_2 = polyval(Plot_2Degree, Strain_Amplitude)  
plot(Strain_Amplitude, Complex_Modulus, 'mo-', Strain_Amplitude, y_fit_2)  
xlabel('Strain Amplitude')  
ylabel('Complex Modulus')  
  
% Finding the value of 'a' , 'b' , 'c' in y = ax2 + bx + c ;  
Plot_2Degree = polyfit(Strain_Amplitude, Complex_Modulus, 2) % 2 --> Represents the degree of curve  
  
y_fit_2 = polyval(Plot_2Degree, Strain_Amplitude)  
plot(Strain_Amplitude, Complex_Modulus, 'mo-', Strain_Amplitude, y_fit_2)  
xlabel('Strain Amplitude')  
ylabel('Complex Modulus')  
  
% Plotting Cubic Curve using plot()  
y_fit_3 = polyval(Plot_3Degree, Strain_Amplitude)  
plot(Strain_Amplitude, Complex_Modulus, 'mo-', Strain_Amplitude, y_fit_3)  
xlabel('Strain Amplitude')  
ylabel('Complex Modulus')
```

Strain Amplitude	Complex Modulus (Y)
0.0167	-0.45
0.1487	0.447
0.2807	1.978
0.4127	3.28
0.5447	6.16
0.6767	7.34
0.8087	7.66
0.9407	9.56
1.0000	11.4

```
% Finding the value of 'a' , 'b' , 'c' in y = ax2 + bx + c ;  
Plot_2Degree = polyfit(Strain_Amplitude, Complex_Modulus, 2) % 2 --> Represents the degree of curve  
  
y_fit_2 = polyval(Plot_2Degree, Strain_Amplitude)  
plot(Strain_Amplitude, Complex_Modulus, 'mo-', Strain_Amplitude, y_fit_2)  
xlabel('Strain Amplitude')  
ylabel('Complex Modulus')  
  
% Plotting Cubic Curve using plot()  
y_fit_3 = polyval(Plot_3Degree, Strain_Amplitude)  
plot(Strain_Amplitude, Complex_Modulus, 'mo-', Strain_Amplitude, y_fit_3)  
xlabel('Strain Amplitude')  
ylabel('Complex Modulus')
```

Strain Amplitude	Complex Modulus (Y)
0.0167	-0.45
0.1487	0.447
0.2807	1.978
0.4127	3.28
0.5447	6.16
0.6767	7.34
0.8087	7.66
0.9407	9.56
1.0000	11.4

Strain Amplitude	Complex Modulus (Y)
0.0167	-0.45
0.1487	0.447
0.2807	1.978
0.4127	3.28
0.5447	6.16
0.6767	7.34
0.8087	7.66
0.9407	9.56
1.0000	11.4

MATLAB

https://matlab.mathworks.com

HOME PLOTS APPS LIVE EDITOR INSERT VIEW

New Open Save Go To Bookmarks Text Normal B I U M Code Control Task Refactor Section Break Run Section Run and Advance Run to End Run to End SECTION RUN

FILE NAVIGATE MATLAB Drive

WORKSPACE CURRENT FOLDER

```
% Test.mlx
% 2019BTECS080_Kishan_Gupta_Skm_04_Activity.mlx
% xlabel('Complex Modulus')

42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78

% Finding the value of 'a' , 'b' , 'c', 'd', 'e' in y = ax5 + bx4 + cx3 + dx2 + ex + f ;
Plot_5Degree = polyfit(Strain_Amplitude, Complex_Modulus, 5) % 5 --> Represents the degree of curve

% Plotting Quadratic Curve using plot()
y_fit_5 = polyval(Plot_5Degree, Strain_Amplitude)
plot(Strain_Amplitude, Complex_Modulus, 'mo-', Strain_Amplitude, y_fit_5)
xlabel('Strain Amplitude')
ylabel('Complex Modulus')
```

Strain\_Amplitude = 1×9  
0.0167 0.1367 0.2567 0.3767 0.4967 0.6167 0.7367 ...

Complex\_Modulus = 1×9  
-0.4500 0.4470 1.9780 3.2800 6.1600 7.3400 7.6600 ...

Plot\_5Degree = 1×6  
82.7584 -144.2724 53.9281 16.9827 3.3214 -0.4825

y\_fit\_5 = 1×9  
-0.4221 0.3882 1.8672 3.7839 5.6861 7.1873 8.2058 ...

MATLAB

https://matlab.mathworks.com

HOME PLOTS APPS LIVE EDITOR INSERT FIGURE

XLabel YLabel Title Legend Remove L... Colorbar Remove ... Grid Remove ... X-Grid Y-Grid Text Arrow

ANNOTATIONS

WORKSPACE CURRENT FOLDER

```
% Test.mlx
% 2019BTECS080_Kishan_Gupta_Skm_04_Activity.mlx
% xlabel('Complex Modulus')

91
92
93
94
95
96
97
98
99
100
101
102
103
104
105
106
107
108
109
110
111
112
113
114
115
116
117
118
119
120
121
122
123
124
125
126
127
128
129

Plot_10Degree = polyfit(Strain_Amplitude, Complex_Modulus, 10) % 10 --> Represents the degree of curve

% Plotting Quadratic Curve using plot()
y_fit_10 = polyval(Plot_10Degree, Strain_Amplitude)
plot(Strain_Amplitude, Complex_Modulus, 'mo-', Strain_Amplitude, y_fit_10)
xlabel('Strain Amplitude')
ylabel('Complex Modulus')
```

Strain\_Amplitude = 1×9  
0.0167 0.1367 0.2567 0.3767 0.4967 0.6167 0.7367 ...

Complex\_Modulus = 1×9  
-0.4500 0.4470 1.9780 3.2800 6.1600 7.3400 7.6600 ...

Warning: Polynomial is not unique; degree >= number of data points.

Plot\_10Degree = 1×11  
0.4672 0 -3.2404 4.4468 0 -4.0057 3.3516 ...

y\_fit\_10 = 1×9  
-0.4500 0.4470 1.9780 3.2800 6.1600 7.3400 7.6600 ...

# SKILL ACTIVITY NO: 5

(Application of Testing of hypothesis using T-Test for Real-World Problems via MATLAB)

Date: 27<sup>th</sup> June 2021

## SKILL ACTIVITY 05 "

TITLE: Application of Testing of hypothesis using T-Test  
for Realworld Problems via MATLAB Date: 27<sup>th</sup> June 2021

1. What is the purpose of this activity? (Explain in 3-4 lines)

Purpose of this activity is to find out:-

- ↳ what does Testing of Hypothesis mean?
- ↳ What is t-test? What are its properties?
- ↳ How to apply t-test? Where to apply T-test?
- ↳ Application of T-test in Real world problems
- ↳ How to use MATLAB pre-defined functions for t-test implication?

2. Steps performed in this Activity. (Explain in 5-6 lines)

↳ Step①: Collect the Sample dataset for performing T-test.  
Note: {Sample size ( $\leq 30$ )} for t-test.

↳ Step②: Find the Theoretical mean value which was already provided in question.

↳ Step③: & Define a Null Hypothesis with mean  $\leftarrow$  Theoretical (Actual mean)

↳ Step④: Then apply below mathematical formula  
to perform t-test i.e.

$$t = \frac{m - \mu}{s} * \sqrt{n}$$

Here,  $m$  represents mean

$\mu$  — Theoretical mean value

$s$  — Standard Deviation

$n$  — Variable set size & Total No of observations!

↳ Step⑤: After calculating  $t^*$  value, then find standardt by using  $tinv()$  of matlab.

↳ Function for computing student's(t-test) inverse distribution function,

↳ Then simply compare  $t^*$  value & standardt ( ) value

↳ Step⑥: Then simply compare  $t^*$  value & standardt ( )

If  $t^* < \text{standardt}()$   
↳ Null Hypo  $\rightarrow$  is Accepted

else rejected.

3. What Resources/ Materials/ Equipment's/ Tools did you use for this Activity?

- a. Matlab 30 Days Free Trial Software (2021a)
- b. Matlab Online Help Documentation
- c. Realworld dataset of COVID-19 Second Wave M.P Dataset

4. What skills did you acquire?

- How to apply t-test in Realworld problems?
- Usecase of Testing of Hypothesis.
- Properties of (t-test) & ~~W5HH~~ regarding (t-test)
- Use of t-test in Covid-19 dataset { Related to Deaths of Person }

5. Time taken to perform this activity? 05:00 (HOURS)

ygupta  
Signature of Students

## (To be filled by Faculty)

Sr. No.	Skill /Competencies	(Achieved / Not Achieved) (Yes / No)

Remarks :

Total mark \_\_\_\_\_ out of 10.

Signature of Faculty

Date: \_\_\_\_\_

## Details of Activity:

### MATLAB CODE:

The screenshot shows the MATLAB Live Editor interface. The code is titled "Matlab\_Skill\_05\_performed\_by\_YASH\_GUPTA\_2019BTCS088.mlx". The code performs a t-test to check if the mean number of deaths in 52 districts of Madhya Pradesh is 100. It includes comments explaining the null hypothesis (mean equals 100), the alternative hypothesis (mean not equals 100), and the calculation of the t-test value. The results show that the calculated t-value is 2.6757, which is greater than the critical value of 1.9689 at the 1% significance level, leading to the acceptance of the null hypothesis.

```
Matlab_Skill_05_performed_by_YASH_GUPTA_2019BTCS088
Write MATLAB code for testing the hypothesis using T-test

Question: We are going to take the Real-world use case i.e Covid-19 Pandemic in India. Our sample data is of entire Madhya Pradesh as State that means we gonna take all the deaths in 52 districts. By using t-test to check that death mean is 100 peoples in each district of Madhya Pradesh for 1% level of significance & 5 degree of freedom.

Total Deaths = 8615 ;
Districts = [Agar Malwa, Alirajpur, Anuppur, Ashoknagar, Balaghat, Barwani, Betul, Bhind, Bhopal, Burhanpur, Chhatarpur Chhindwara, Damoh, Datala, Dewas, Dhar, Dindori, Guna, Owlia, Harda, Hoshangabad, Indore, Jabalpur, Jhabua, Katni, Khandwa, Khargone, Mandla, Mandaur, Morena, Narsinghpur, Neemuch, Niwari, Panna, Raisen, Rajgarh, Ratlam, Rewa, Sagar, Satna, Sehore, Seoni, Shahdol, Shajapur, Sheopur, Singarpur, Sidhi, Singrauli, Tikamgarh, Ujjain, Umriya, Vidisha] ;

Deaths = [56, 47, 87, 36, 64, 89, 228, 32, 971, 39, 91, 120, 175, 78, 51, 128, 29, 44, 618, 95, 99, 1373, 648, 59, 113, 94, 234, 19, 84, 89, 81, 84, 49, 60, 192, 142, 330, 136, 344, 728, 52, 29, 117, 60, 70, 125, 87, 80, 110, 171]

clc ; clear all
% Solution
% We want to test whether 100 peoples on an average are died in each district
% or less or more than 100. So we have to do quantitative analysis using t-test.

% Testing of hypothesis using t-test
fprintf('We assume our Null Hypothesis: Mean equals to 100 peoples')
% Our Alternative hypothesis
fprintf('So our Alternate Hypothesis is: Mean not equals to 100 peoples')

% Our Real-World Dataset
Deaths = [ 56, 47, 87, 36, 64, 89, 228, 32, 971, 39, 91, 120, 175, 78, 51, 128, 29, 44, 618, 95, 99, 1373, 648, 59, 113, 94, 234, 19, 84, 89, 81, 84, 49, 60, 192, 142, 330, 136, 344, 728, 52, 29, 117, 60, 70, 125, 87, 80, 110, 171];

% Mathematical Formula for finding t-test is
% T_Test_Value = ((Actual_Mean -Theoretical_Mean)./(Standard_Deviation)).*(sqrt(length(x)))
% As per question formula is
Theoretical_Mean = 100
Actual_Mean = mean(Deaths)
Standard_Deviation = std(Deaths)
T_Test_Value = ((Actual_Mean - Theoretical_Mean)/Standard_Deviation)*(sqrt(length(Deaths)))

% As per question for finding Standard Value of T_Test_Value at 1% level
% As per question for finding Standard Value of T_Test_Value at 1% level
Tablet = Standard_Tf1,2;

% To check whether null hypothesis is correct or not
if T_Test_Value < Tablet
    display ("Null hypothesis is accepted")
else
    display ("Null hypothesis is rejected")
end
```

We assume our Null Hypothesis: Mean equals to 100 peoples  
So our Alternate Hypothesis is: Mean not equals to 100 peoples

Deaths = 1x52  
56 47 87 36 64 89 228 32 971 39 91 120 175 78 51 128 29 44 618 95 99 1373 648 59 113 94 234 19 84 89 81 84 49 60 192 142 330 136 344 728 52 29 117 60 70 125 87 80 110 171

Theoretical\_Mean = 100  
Actual\_Mean = 105.6731  
Standard\_Deviation = 241.1356  
T\_Test\_Value = 1.9689

Tablet = 2.6757

"Null hypothesis is accepted"