



Symbiosis University of Applied Sciences

Front Page of Answer Book

Enrollment Number:

2	0	1	9	B	T	C	S	0	8	8
---	---	---	---	---	---	---	---	---	---	---

Name of Student: YASH GUPTA

Name of Program: B. TECH

Year/Semester: 2ND YEAR/4TH SEMESTER

Name of Paper: Statistics-II

Paper Code: BTCS04CFB2

Date: 20th-JULY-2021

Day: TUESDAY

Time: 09:00 AM – 10:00 AM

Total No. of Pages.: 09

Instructions for Examinees

1. Fill up all entries required in this page.
2. Merge this doc page with your scanned answer sheets as a first page in a single PDF file.
3. Write your answers on A4 Ruled Sheets/Register Pages.
4. Write End after the last attempted question.
5. Write the page number on every page and mentioned Total No. of Pages on front Page.
6. **If the content in the Answer Book of two students or more has found similar, in that case all copied answer will stand cancelled.**

PRACTICAL ACTIVITY

1. Title:

le:
Finding MODE for all 3 types of Series using Mathlab

2. Aim/Objective:

AIM/OBJECTIVE:
The objective is to find MODE for 3 types of series i.e.

- (a) Individual Series using MATLAB
(b) Discrete Series
(c) Continuous Series

(c) Continuous Series

{ Inclusive Series } \longleftrightarrow { Exclusive Series }

3. METHODOLOGY USED:

METHODOLOGY USED:

a. For finding MODE of Individual Series using MATLAB:

a. For finding mode of data

Step 1 → Directly use the pre-created function of MATLAB to find the mode (i.e. highest frequency) i.e. mode() provide the series variable as Argument.

⇒ mode = mode(X)

$$\Rightarrow \text{mode} = \text{mode}(\underline{x})$$

b. For finding MODE of Discrete Series using MATLAB :-

Step ① → Here, we have to use some operations of array in matlab in order to find mode.
first create a table where both 'x' and their respective frequencies (f) are mapped.

Step ② Then perform an operation which will traverse all the elements of array & find out the max value of frequency.

Step ③ Then it will simply traverse the address & provide to us.
The operation we perform is

Mode

Array = [x₁ f₁; x₂ f₂; ...; x_n f_n]

array Var Name → mode = Array(Array(:, 2)) == max(Array(:, 2), 1)

Simply, we get that value of x which has highest frequency in series.

© For finding MODE of Continuous Series using MATLAB:-

Here, we have Assigned a {Class-Interval} and their respective {Frequencies} → so, in order to find Mode

Also, in continuous series, we have 2 types:-



For these type of series we first convert them into exclusive ones & then apply the mathematical formula in MATLAB:

For these type of series we find out the MODAL CLASS and then apply the mathematical formula in MATLAB.

Step ②: Find out modal class which class has ^{highest} maximum frequency & then apply the mathematical formula.

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

L ← Lower limit of Modal Class
 f_1 ← Freq. of Modal Class
 f_0 ← Freq. of Pre-Modal Class
 f_2 ← Freq. of Post-Modal Class
 h ← Class Interval

Step ③ By putting all the above values, in mathematical expression, we get our MODE.

5. BRIEF DESCRIPTION:-

- ① Mode can be defined as Most Frequent value / Most Typical value / Most Predominant Value / Most Fashionable Value / Most Trending Value
- ② Series can have one mode (Uni-modal series), two modes (Bi-modal series), or more than two modes (Multi-modal series)
- ③ When all the observations occur with same frequency then there is NO mode.

④ Mode → Not rigidly defined & it's most unstable average.

⑤ It doesn't follow mathematical / algebraical properties.

MATLAB CODE:

A. Example 1: MODE for Individual Series.

The screenshot shows the MATLAB Live Editor interface. The left pane contains the code, and the right pane shows the output. The code defines a vector 'Marks' and calculates its mode using the 'mode' function. It also displays the 'Marks' as a table and prints the mode value.

```
% Matlab_Practical_04_performed_by_YASH GUPTA_2019BTC5088
%
% Write MATLAB code for finding Mode of Individual Series
% Question_01: Marks of 5 students are given
% Marks = [2, 5, 10, 9, 7, 8, 3, 2, 2, 5, 7, 8]
% Find out the Mode.
% Solution:
% Given: Marks of Student given in Individual Series
Marks = [2, 5, 10, 9, 7, 8, 3, 2, 2, 5, 7, 8]
Mode_01 = mode(Marks)
%
% Tabular View
Student_Marks = table(Marks);
Student_Marks.Properties.VariableNames = { 'Marks(X)' }
% Method 1: Via observing the highest frequency
fprintf('Mode is %f', Mode_01)
% %
```

Marks = 1x12
2 5 10 9 7 8 3 2 2 5 7 ...

Mode_01 = 2
Student_Marks = 12x1 table

	Marks(X)
1	2
2	5
3	10
4	9
5	7
6	8
7	3
8	2
9	2

Mode is 2.000000

B. Example 1: MODE for Discrete Series.

The screenshot shows the MATLAB Live Editor interface. The left pane contains the code, and the right pane shows the output. The code defines a vector 'Petrol_Price' and calculates its mode using the 'mode' function. It also displays the 'Petrol_Price' as a table and prints the mode value.

```
% Question_03: Petrol prices(in Rs.) increased in 1 month duration are given
% Petrol_Price = [2, 0.5, 1.0, 0.9, 0.72, 0.8, 3.2, 1.0, 2.0, 1.0, 0.75]
% Cities = [GangaNagar, Indore, Bhopal, Pune, Kota]
% GangaNagar => 1, Indore => 2, Bhopal => 3, Pune => 4, Kota => 5
% Find out the Mode.
% Solution:
% Given: Petrol price's given in Discrete Series
Cities = [1, 2, 3, 4, 5]
Petrol_Price = [2, 0.5, 1.0, 0.9, 0.72]
% Combining Cities-Deaths Array
CP = [1 2 ; 2 0.5 ; 3 0.5 ; 4 0.9 ; 5 0.72];
% Tabular View
Price = table(Cities, Petrol_Price);
Price.Properties.VariableNames = {'Cities' 'Petrol_Price(f)'}
% Performing below formula of Mode of Discrete Series
Mode = CP(CP(:,2) == max(CP(:,2)), 1);
% Method 1: Via observing the highest frequency
fprintf('Mode is %f i.e. in GangaNagar city', Mode)
% %
```

Cities = 1x5
1 2 3 4 5

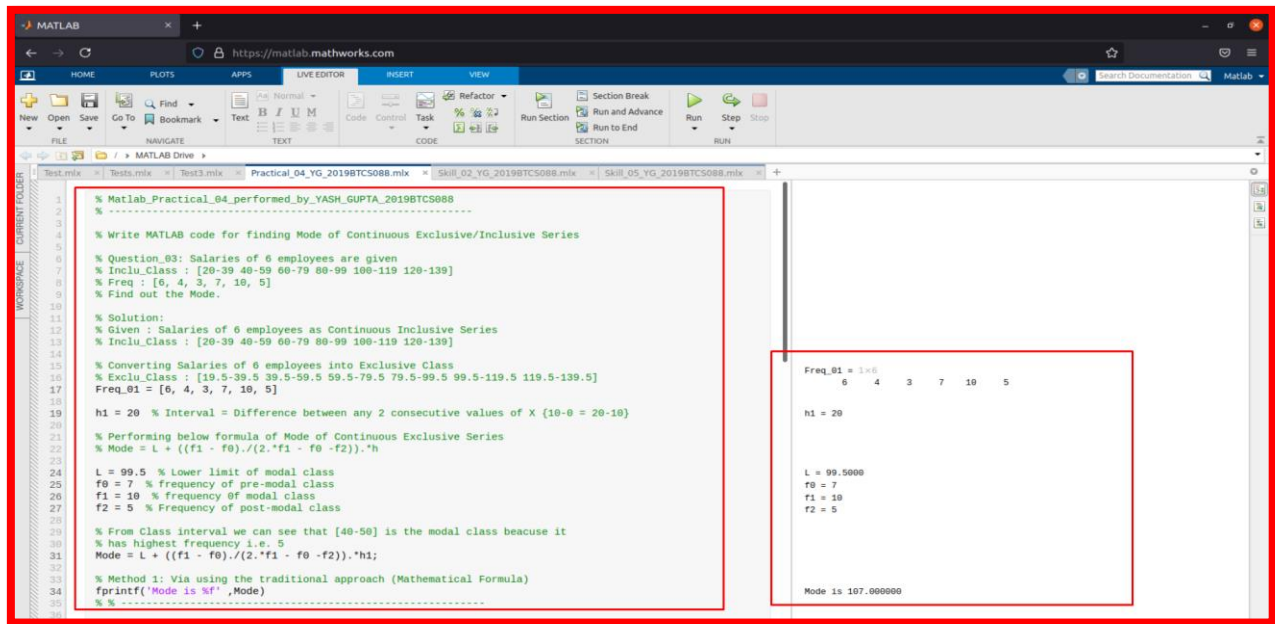
Petrol_Price = 1x5
2.0000 0.5000 1.0000 0.9000 0.7200

Price = 5x2 table

	Cities	Petrol_Price(f)
1	1	2
2	2	0.5000
3	3	1
4	4	0.9000
5	5	0.7200

Mode is 1.000000 i.e. in GangaNagar city

C. Example 1: MODE for Continuous Series.



The image shows a MATLAB Live Editor window with a red border. The code in the editor calculates the mode of a continuous series. It starts with a comment and a task description. It then defines the salary classes and frequencies for 6 employees. The code converts these into an exclusive class and calculates the frequency of the modal class (f1 = 10) and the classes immediately before (f0 = 7) and after (f2 = 5) it. It then uses the formula for the mode of a continuous series to find the mode, which is 107.000000. The output window on the right displays the frequency distribution table and the calculated mode.

```
1 % Matlab_Practical_04_performed_by_YASH_GUPTA_2019BTC5088
2 % -----
3 % Write MATLAB code for finding Mode of Continuous Exclusive/Inclusive Series
4
5 % Question_03: Salaries of 6 employees are given
6 % Inclu_Class : [20-39 40-59 60-79 80-99 100-119 120-139]
7 % Freq : [6, 4, 3, 7, 10, 5]
8 % Find out the Mode.
9
10
11 % Solution:
12 % Given : Salaries of 6 employees as Continuous Inclusive Series
13 % Inclu_Class : [20-39 40-59 60-79 80-99 100-119 120-139]
14
15 % Converting Salaries of 6 employees into Exclusive Class
16 % Exclu_Class : [19.5-39.5 39.5-59.5 59.5-79.5 79.5-99.5 99.5-119.5 119.5-139.5]
17 Freq_01 = [6, 4, 3, 7, 10, 5]
18
19 h1 = 20 % Interval = Difference between any 2 consecutive values of X (10-0 = 20-10)
20
21 % Performing below formula of Mode of Continuous Exclusive Series
22 % Mode = L + ((f1 - f0) / (2*f1 - f0 - f2)) * h1
23
24 L = 99.5 % Lower limit of modal class
25 f0 = 7 % frequency of pre-modal class
26 f1 = 10 % frequency of modal class
27 f2 = 5 % Frequency of post-modal class
28
29 % From Class interval we can see that [40-50] is the modal class because it
30 % has highest frequency i.e. 5
31 Mode = L + ((f1 - f0) / (2*f1 - f0 - f2)) * h1;
32
33 % Method 1: Via using the traditional approach (Mathematical Formula)
34 fprintf('Mode is %f', Mode)
35 % % -----
36
```

Output:

```
Freq_01 = 1x6
         6         4         3         7        10         5

h1 = 20

L = 99.5000
f0 = 7
f1 = 10
f2 = 5

Mode is 107.000000
```


SKILL ACTIVITY

SKILL ACTIVITY-01

Date: 15th June 2021

TITLE: Mean Deviation ^{from} ~~about~~ 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:-

- ↳ (a) What is Mean-Deviation? Why we need it?
- ↳ (b) Need of Mean-Deviation in Real world use-cases.
- ↳ (c) How to find Mean Deviation?
- ↳ (d) How to find mean-deviation ^{from} ~~about~~ 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

(a) Individual Series

- ↳ Step ① Store the dataset in the variable 'X'.
- ↳ Step ② Find the mean using `mean()` of Matlab.
- ↳ Step ③ Find the absolute of ~~the~~ X-Mean i.e. Absolute Deviation from mean (i.e. $|X - \bar{X}|$)

↳ Step ④ Find the sum of Absolute Deviation from Mean

↳ Step ⑤ Use below formula to find Mean Deviation i.e.

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

~~(B) For finding Mean Deviation for~~

(b) Discrete Series

↳ Step ①: Here, we have provided ^{respective} frequency of each observation.

↳ Step ②: So first we will find product of frequency & 'X' & find sum of it.

↳ Step ③ Find the Absolute Deviation from mean i.e. $|X - \bar{X}|$

↳ Step ④ Multiply frequency with the Abs. Deviation from Mean.

↳ Step ⑤ Find sum of above product.

↳ Step ⑥ Use below formula to find Mean Deviation i.e.

$$M.D = \frac{\sum f |X - \bar{X}|}{\sum f} \quad \leftarrow \text{Sum of frequencies of all observations}$$

② Continuous Series → Here class intervals are given with their corresponding frequencies.

↳ Step ① First

Find the cumulative frequency (c.f) using cumsum(). & also find the mid-value (i.e. $\frac{L+U}{2}$) from class interval.

↳ Step ② Find the median term using formula $\Rightarrow \left(\frac{\sum f}{2} \right)$

↳ Step ③ From above step we get our Median Class.

↳ Step ④: Now apply Mathematical Formula, & find out Median

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

↳ Step ⑤ Now perform all the same steps we done in Discrete series..

③ For finding Mean Deviation from Mode

a. Individual Series

↳ Step ①: Store the dataset (x) in one variable.

↳ Step ②: Find the mode of 'x' using mode().

↳ Step ③: Then find the Absolute Deviation about Mode using $|x - \text{mode}(x)|$

↳ Step ④: Find the sum of Absolute Deviation about Mode by using sum() function.

↳ Step ⑤: Use below formula to find Mean Deviation i.e.

$$M.D = \frac{\sum |x - \text{mode}(x)|}{N} \quad \leftarrow \begin{array}{l} \text{Total No. of} \\ \text{observations in} \\ 'x' \end{array}$$

b. Discrete Series

↳ Step ①: Here, we have provided respective frequency of each observation.

↳ Step ②: Concat both of the arrays i.e. 'x' and 'f' into one array.

↳ Step ③: Find mode by performing one MATLAB operation on the concatenated array, i.e.

$$\text{Array} = (X(X(:,2) == \max(X(:,2)), 1))$$

↳ Step ④ Find the Absolute Deviation about mode.

↳ Step ⑤ Find sum of Abs. Deviation & multiply with frequency

↳ Step ⑥ Use below formula to find Mean Deviation i.e.

$$M.D = \frac{\sum f_i (x_i - \text{mode}(x_i))}{\sum f_i}$$

c. Continuous Series

↳ step ①: Here, Class Intervals are provided in question with their corresponding frequencies.

↳ step ②: First findout the mid-value from class interval using

$$\text{Mid-value} = (\text{Upper Limit} + \text{Lower Limit}) / 2$$

↳ step ③: Store the mid values as 'x' & their respective frequencies as 'f'.

↳ step ④: Finding the Modal Class by finding highest frequency using same operation we done in Discrete Series.

↳ step ⑤: Find the mode using mathematical formula

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

↳ step ⑥: Find Absolute deviation about mode using
 $|x - \text{Mode}(x)|$

↳ step ⑦: Finding sum of Absolute Devio' abt Mode using sum()

↳ step ⑧: Use below formula to find Mean Deviation i.e.

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

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

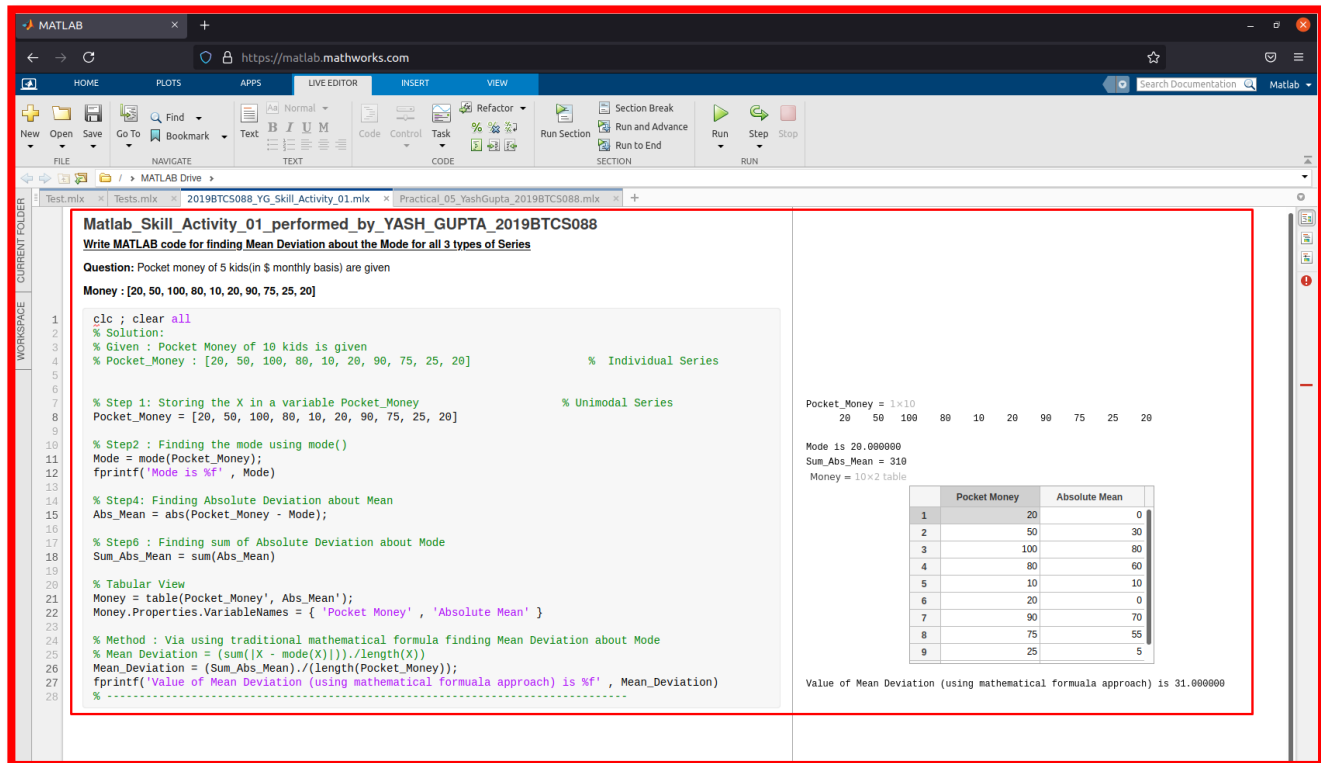
↳ Use of mean(), median(), mode(), function.

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

Y. Gupta
 Signature of Student

MATLAB CODE:

A. Example 1: Mean Deviation about MODE for Individual Series Problem.



The screenshot shows the MATLAB Live Editor interface. The title bar indicates the file is '2019BTC5088_YG_Skill_Activity_01.mlx'. The editor contains MATLAB code for finding the mean deviation about the mode for an individual series. The code includes comments for each step, from storing the data to calculating the mean deviation using both a built-in function and a manual formula. The workspace on the right shows the variables 'Pocket_Money' (1x10 array), 'Mode' (20), 'Sum_Abs_Mean' (310), and 'Money' (10x2 table).

Matlab Skill Activity_01_performed_by_YASH GUPTA_2019BTC5088
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]

```
1 clc ; clear all
2 % Solution:
3 % Given : Pocket Money of 10 kids is given
4 % Pocket_Money = [20, 50, 100, 80, 10, 20, 90, 75, 25, 20] % Individual Series
5
6
7 % Step 1: Storing the X in a variable Pocket_Money % Unimodal Series
8 Pocket_Money = [20, 50, 100, 80, 10, 20, 90, 75, 25, 20]
9
10 % Step2 : Finding the mode using mode()
11 Mode = mode(Pocket_Money);
12 fprintf('Mode is %f' , Mode)
13
14 % Step4: Finding Absolute Deviation about Mean
15 Abs_Mean = abs(Pocket_Money - Mode);
16
17 % Step6 : Finding sum of Absolute Deviation about Mode
18 Sum_Abs_Mean = sum(Abs_Mean)
19
20 % Tabular View
21 Money = table(Pocket_Money', Abs_Mean');
22 Money.Properties.VariableNames = { 'Pocket Money' , 'Absolute Mean' }
23
24 % Method : Via using traditional mathematical formula finding Mean Deviation about Mode
25 % Mean Deviation = (sum(|X - mode(X)|))/length(X)
26 Mean_Deviation = (Sum_Abs_Mean)/length(Pocket_Money);
27 fprintf('Value of Mean Deviation (using mathematical formula approach) is %f' , Mean_Deviation)
28 %
```

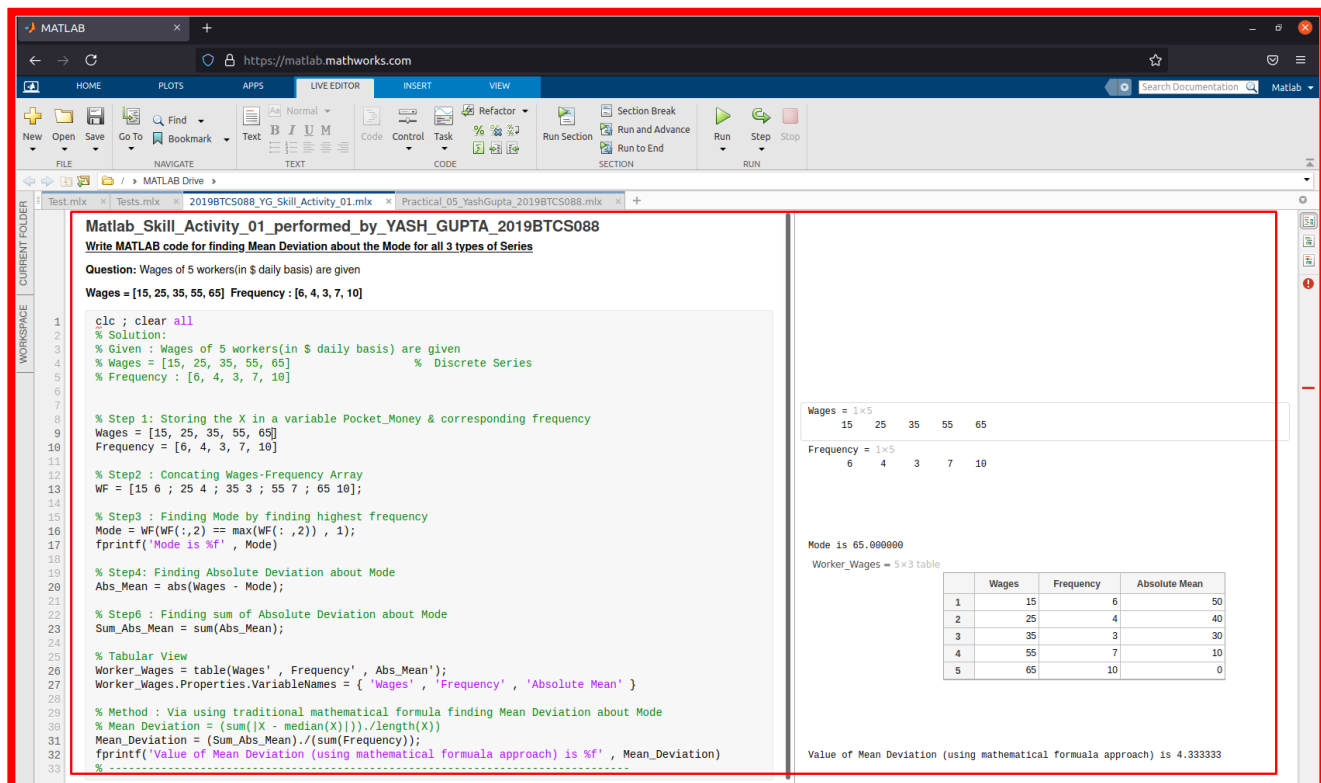
Pocket_Money = 1x10
20 50 100 80 10 20 90 75 25 20

Mode is 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

B. Example 1: Mean Deviation about MODE for Discrete Series Problem.



The screenshot shows the MATLAB Live Editor interface. The title bar indicates the file is '2019BTC5088_YG_Skill_Activity_01.mlx'. The editor contains MATLAB code for finding the mean deviation about the mode for a discrete series. The code includes comments for each step, from storing the wages and frequencies to calculating the mean deviation using both a built-in function and a manual formula. The workspace on the right shows the variables 'Wages' (1x5 array), 'Frequency' (1x5 array), 'Mode' (65), and 'Worker_Wages' (5x3 table).

Matlab Skill Activity_01_performed_by_YASH GUPTA_2019BTC5088
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]

```
1 clc ; clear all
2 % Solution:
3 % Given : Wages of 5 workers(in $ daily basis) are given
4 % Wages = [15, 25, 35, 55, 65] % Discrete Series
5 % Frequency : [6, 4, 3, 7, 10]
6
7
8 % Step 1: Storing the X in a variable Pocket_Money & corresponding frequency
9 Wages = [15, 25, 35, 55, 65]
10 Frequency = [6, 4, 3, 7, 10]
11
12 % Step2 : Concating Wages-Frequency Array
13 WF = [15 6 ; 25 4 ; 35 3 ; 55 7 ; 65 10];
14
15 % Step3 : Finding Mode by finding highest frequency
16 Mode = WF(WF(:,2) == max(WF(:,2)) , 1);
17 fprintf('Mode is %f' , Mode)
18
19 % Step4: Finding Absolute Deviation about Mode
20 Abs_Mean = abs(Wages - Mode);
21
22 % Step6 : Finding sum of Absolute Deviation about Mode
23 Sum_Abs_Mean = sum(Abs_Mean);
24
25 % Tabular View
26 Worker_Wages = table(Wages', Frequency', Abs_Mean');
27 Worker_Wages.Properties.VariableNames = { 'Wages' , 'Frequency' , 'Absolute Mean' }
28
29 % Method : Via using traditional mathematical formula finding Mean Deviation about Mode
30 % Mean Deviation = (sum(|X - median(X)|))/length(X)
31 Mean_Deviation = (Sum_Abs_Mean)/(sum(Frequency));
32 fprintf('Value of Mean Deviation (using mathematical formula approach) is %f' , Mean_Deviation)
33 %
```

Wages = 1x5
15 25 35 55 65

Frequency = 1x5
6 4 3 7 10

Mode is 65.000000
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

C. Example 1: Mean Deviation about MODE for Continuous Series Problem.

Matlab_Skill_Activity_01_performed_by_YASH_GUPTA_2019BTC5088
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]

```
1 clc; clear all
2 % Solution:
3 % Given : Salaries of 6 employees (in $ thousand) are given
4 % Exclusive_Class : [20-25 25-30 30-35 35-40 40-45 45-50]
5 % Frequency : [6, 4, 3, 7, 10, 5]
6 % Continuous Exclusive Series
7
8 % Step 1: Finding the Mid-Value from Class Interval
9 Salaries = [22.5, 27.5, 32.5, 37.5, 42.5, 47.5]
10 Frequency = [6, 4, 3, 7, 10, 5]
11
12 % Step2: Concating the Salaries & Frequency Array in order to Find Modal Class
13 SF = [22.5 6 ; 27.5 4 ; 32.5 3 ; 37.5 7 ; 42.5 10 ; 47.5 5]
14
15 % Step2 : Finding Modal Class by finding highest frequency
16 Modal_Class = SF(SF(:,2) == max(SF(:,2)), 1);
17 fprintf('Highest frequency is of %f', Modal_Class)
18 fprintf('Hence, Modal Class is 40-45')
19
20 % Using below mathematical formula for finding mode
21 % Mode = L + ((f1 - f0) / (2 * f1 - f0 - f2)) * h
22 L = 40; % Lower limit of modal class
23 f0 = 7; % Frequency of pre-modal class
24 f1 = 10; % Frequency of modal class
25 f2 = 5; % Frequency of post-modal class
26 h = 5; % Interval -> Difference between any 2 consecutive values of X (25-20 = 30-25)
27
28 % Step3 : Finding Mode using Mathematical Formula
29 Mode = L + ((f1 - f0) / (2 * f1 - f0 - f2)) * h
30
31 % Step4: Finding Absolute Deviation about Mode
32 Abs_Mean = abs(Salaries - Mode);
33
34 % Step6 : Finding sum of Absolute Deviation about Mode
35 Sum_Abs_Mean = sum(Abs_Mean);
36
37 % Tabular View
38 Worker_Wages = table(Salaries, Frequency, Abs_Mean);
39 Worker_Wages.Properties.VariableNames = {'Wages', 'Frequency', 'Absolute Mean'};
40
41 % Method : Via using traditional mathematical formula Finding Mean Deviation about Mode
42 % Mean Deviation = (sum(|X - median(X)|)) / length(X)
43 Mean_Deviation = (Sum_Abs_Mean) / (sum(Frequency));
44 fprintf('Value of Mean Deviation (using mathematical formula approach) is %f', Mean_Deviation)
45
```

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	19.3750
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 1.535714