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### CSDS LAB - III

Aim - To describe the nature of given curve using Moment, skewness and kurtosis.

A) History - The  $r^{\text{th}}$  moment about the mean of a distribution is denoted by  $\mu_r$  and is given by -

$$\mu_r = \frac{1}{N} \sum f (n - \bar{n})^r \quad \text{where } N = \sum f$$

Putting  $r = 0, 1, 2, \dots$  we get

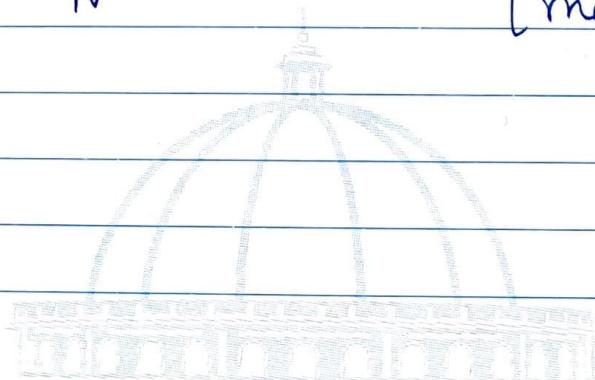
$$\mu_0 = \frac{1}{N} \sum f (1)$$

$$\mu_1 = \frac{1}{N} \sum f (n - \bar{n})^1 = \bar{n} - \bar{n} = 0 \quad \begin{bmatrix} \text{First moment} \\ \text{about mean} \end{bmatrix}$$

$$\mu_2 = \frac{1}{N} \sum f (n - \bar{n})^2 = \sigma^2 = V = \text{variance gives second moment about mean.}$$

$$\mu_3 = \frac{1}{N} \sum f (n - \bar{n})^3 = \begin{bmatrix} \text{Third moment about} \\ \text{mean} \end{bmatrix}$$

$$\mu_4 = \frac{1}{N} \sum f (n - \bar{n})^4 = \begin{bmatrix} \text{Fourth moment about} \\ \text{mean} \end{bmatrix}$$



B)  $\mu_0 = 1, \mu_1 = 0$

$$\mu_2 = \mu'_2 - (\mu'_1)^2$$

$$\mu_3 = \mu'_3 - 3(\mu'_2 \cdot \mu'_1) + 2(\mu'_1)^3$$

$$\mu_4 = \mu'_4 - 4(\mu'_3 \cdot \mu'_1) + 6(\mu'_2(\mu'_1)^2 - 3(\mu'_1)^4)$$

c) Moment are used to find a probability distribution mean, variance and skewness

D) Example - (-4, 22, -117, 560)

$$\mu_0 = 1$$

$$\mu_1 = 0$$

$$\mu_2 = 22 - (-4)^2 = 22 - 16 = 14$$

$$\mu_3 = -(-117) - 3(22 \cdot (-4)) + 2(-4)^3 = 19$$

$$\mu_4 = 560 - 4((-117) \cdot (-4)) + 6(22 \cdot (-4)^2) - 3(-4)^4 = 32$$

A) History → Skewness helps us to distinguish between different types of distributions.  
A distribution can be positively or negatively skewed.

- If values of mean, median, mode coincide then it is symmetrical distribution
- If value of mean is maximum and mode is least & median lies between mean & mode then



- distribution is positively skewed distribution.
- If value of mode is maximum, mean is less and median lies in between mode & mean then distribution is negatively skewed distribution.

B) Skewness =  $\frac{-3(\text{mean} - \text{median})}{\text{Standard deviation}}$

Coefficient of Skewness  $B_1 = \frac{\mu_3^2}{\mu_2^3}$

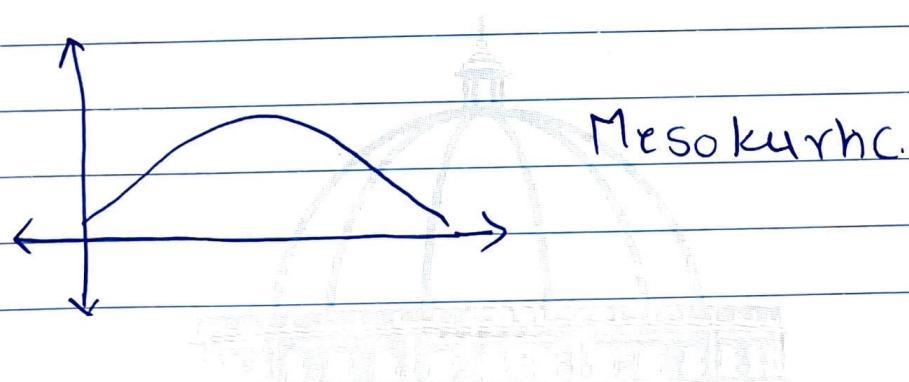
c) We study Skewness to get an idea about the shape of the curve which we draw with given data.

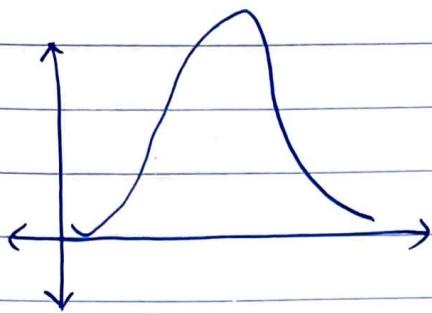
D) for Eg-1 → Continue

Coefficient of Skewness  $B_1 = \frac{(1g)^2}{(14)^2} = 0.13$

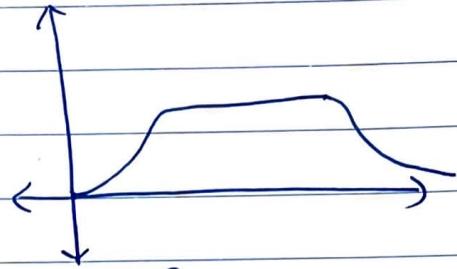
### # Kurtosis

A) History - Kurtosis is studied to get idea about flatness or peakedness of the curve.





leptokurtic



Platykurtic.

If  $\beta_2 = 3$  then curve is mesokurtic

If  $\beta_2 < 3$ , then curve is leptokurtic

If  $\beta_2 > 3$ , then curve is Platykurtic

$$B) \quad \beta_2 = \frac{\mu_4}{\mu_2^2}$$

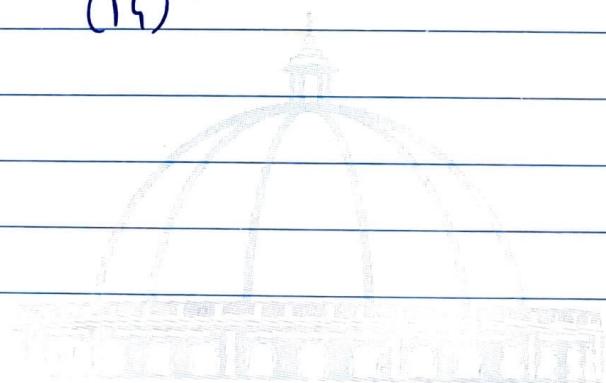
C) To get idea of flatness or peakness of curve

It is a measure of tailedness of distribution  
which tells us how often outlier occurs.

-kurtosis is studied largely in financial analysis to get idea about risk involved.

D) for eg-1  $\rightarrow$  Continued

$$\beta_2 = \frac{32}{(14)^2} = 0.16.$$



3.2.R \* 3.1.R\* Project (None)

Source on Save Run Source

```

1 #Q2) Find central moments and coefficient of skewness and kurtosis for the given data points
2 library(readxl)
3 data_q2 <- read_excel("Lab3.xlsx")
4 data_q2
5
6 add_f = sum(data_q2$f)
7
8 x_bar = sum(data_q2$f * data_q2$x) / add_f
9 message("x_bar: ", x_bar)
10
11 for (r in 1:4) {
12   moment = sum(data_q2$f * (data_q2$x - x_bar)^r) / add_f
13   message("r: ", r)
14   message("moment: ", moment, "\n")
15 }
16
17

```

2:16 (Top Level) :

Console Terminal Background Jobs

R 4.2.1 · ~/Documents/MTECH(DSA)/LAB/CSDS Labs/

```

> source("~/Documents/MTECH(DSA)/MyLabWork/CSDS_Lab/Lab3/3.2.R")
x_bar: 3.01492537313433
r: 1
moment: 2.65127886477649e-16

r: 2
moment: 0.529627979505458

r: 3
moment: -0.0311806970937246

r: 4
moment: 0.45824313570446

```

Run Import Dataset 199 MiB Global Environment

Environment History Connections Tutorial

Data

data_q2	5 obs. of 2 variables
add_f	67
moment	0.45824313570446
r	4L
x_bar	3.01492537313433

Files Plots Packages Help Viewer Presentation

Zoom Export Publish

### Histogram of skw

Frequency

skw



```
3.2.R x 3.1.R* x
Source on Save Run Source
1 #Q1)The first four moments about the working mean 5 of a distribution are -4, 22, -117 and 560. Calculate
2
3 mean = 5
4
5 m1 = readline(prompt ="Enter the first moment: ")
6 m1 = as.numeric(m1)
7 m2 = readline(prompt ="Enter the Second moment: ")
8 m2 = as.numeric(m2)
9 m3 = readline(prompt ="Enter the Third moment: ")
10 m3 = as.numeric(m3)
11 m4 = readline(prompt ="Enter the fourth moment: ")
12 m4 = as.numeric(m4)
13
14 n1 = 0
15 n2 = m2-m1^2
16 n3 = m3-(3*m1*m2)+(2*m1^3)
17 n4 = m4-(4*m3*m1)+(6*m2*m1^2)-(3*m1^4)
18
19 message("First Moment about mean : ",n1)
20 message("Second Moment about mean : ",n2 )
21 message("Third Moment about mean : ",n3 )
22 message("Fourth Moment about mean : ",n4 )
```

Console Terminal x Background jobs x

```
R 4.2.1 · ~/Documents/MTECH(DSA)/LAB/CSDS Labs/ ↵
> source("~/Documents/MTECH(DSA)/MyLabWork/CSDS_Lab/Lab3/3.1.R")
Enter the first moment: -4
Enter the Second moment: 22
Enter the Third moment: -117
Enter the fourth moment: 560
First Moment about mean : 0
Second Moment about mean : 6
Third Moment about mean : 19
Fourth Moment about mean : 32
[1] "The graph is said to be positively skewed with the majority
skewness: 1.6712962962963
[1] "The curve is Platykurtic"
Kurtosis: 0.88888888888889
```

Values	
kr	0.888888888888889
m1	-4
m2	22
m3	-117
m4	560
mean	5
n1	0
n2	6
n3	19
n4	32
sk	1.6712962962963
skw	num [1:4] 0 6 19 32

	Name	Size	Modified
<input type="checkbox"/>	 Lab_1_practical.R	881 B	Nov 14, 2022, 2:32 PM
<input type="checkbox"/>	 Lab_2_practical.R	1.3 KB	Nov 14, 2022, 2:32 PM
<input type="checkbox"/>	 Lab_3_practical.R	1.4 KB	Nov 14, 2022, 8:01 PM
<input type="checkbox"/>	 Lab_4_practical.R	416 B	Nov 14, 2022, 2:31 PM
<input type="checkbox"/>	 Lab_5_practical.R	704 B	Nov 14, 2022, 2:31 PM
<input type="checkbox"/>	 Lab1.xlsx	9.6 KB	Nov 14, 2022, 2:31 PM
<input type="checkbox"/>	 Lab3.xlsx	9.5 KB	Nov 14, 2022, 2:31 PM
<input type="checkbox"/>	 Lab4.xlsx	9.8 KB	Nov 14, 2022, 2:31 PM
<input type="checkbox"/>	 Lab5.xlsx	10.3 KB	Nov 14, 2022, 2:31 PM

