ENGINEERING MATHEMATICS

UNIT-3 : *Statistical Techniques – I*

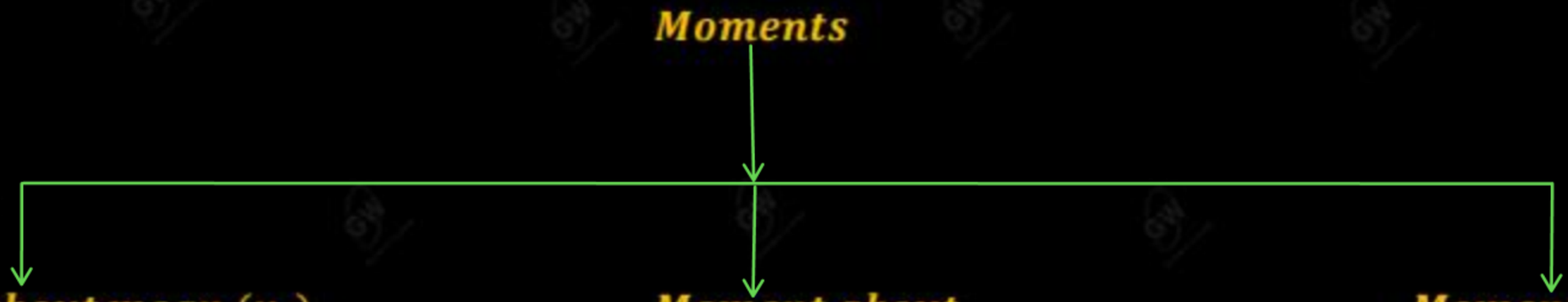
Lec-2

Today's Target

- ***Moments***
- PYQ
- DPP

Moments

Moment of distribution are arithematic mean of various powers of deviation from some given numbers.



(i) For frequency distribution

(ii) For individual series

(i) For frequency distribution

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(ii) For individual series

Moment about mean (μ_r)

For frequency distribution

If $x_1, x_2, x_3 \ldots\ldots x_n$ are n observations with respective frequency $f_1, f_2, f_3 \ldots\ldots f_n$ Respectively.

Then the r^{th} moment μ_r about mean $\bar{x}$ is defined as

$$\mu_r = \frac{\sum f(x-\bar{x})^r}{\sum f}$$

Moment about any arbitrary number (μ'_r)

For frequency distribution

If $x_1, x_2, x_3 \ldots\ldots x_n$ are n observations with respective frequency $f_1, f_2, f_3 \ldots\ldots f_n$ Respectively.

Then the r^{th} moment μ'_r about any arbitrary number (A) is defined as

$$\mu'_r = \frac{\sum f(x-A)^r}{\sum f}$$

Moment about origin (ϑ_r)

For frequency distribution

If $x_1, x_2, x_3 \ldots\ldots x_n$ are n observations with respective frequency $f_1, f_2, f_3 \ldots\ldots f_n$ Respectively.

Then the r^{th} moment ϑ_r about origin (0,0) is defined as

$$\vartheta_r = \frac{\sum f x^r}{\sum f}$$

Moment about mean (μ_r)

Where $r = 0, 1, 2, 3, 4 \ldots$

(i) $\mu_0 = 1$

(ii) $\mu_1 = 0$

(iii) $\mu_2 = \dfrac{\sum f(x-\bar{x})^2}{\sum f}$

Moment about any arbitrary number (μ'_r)

Where $r = 0, 1, 2, 3, 4 \ldots$

$\mu'_0 = 1$

$\mu'_1 = \bar{x} - A$

$\mu'_2 = \dfrac{\sum f(x-A)^2}{\sum f}$

Moment about origin (ϑ_r)

Where $r = 0, 1, 2, 3, 4 \ldots$

$\vartheta_0 = 1$

$\vartheta_1 = \bar{x}$

$\vartheta_2 = \dfrac{\sum f x^2}{\sum f}$

Moment about mean (μ_r)	Moment about any arbitrary number (μ'_r)	Moment about origin (ϑ_r)
(IV) $\mu_3 = \frac{\sum f(x-\bar{x})^3}{\sum f}$	$\mu'_3 = \frac{\sum f(x-A)^3}{\sum f}$	$\vartheta_3 = \frac{\sum f x^3}{\sum f}$
(V) $\mu_4 = \frac{\sum f(x-\bar{x})^4}{\sum f}$	$\mu'_4 = \frac{\sum f(x-A)^4}{\sum f}$	$\vartheta_4 = \frac{\sum f x^4}{\sum f}$

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Moment about mean (μ_r)

For individual series

If $x_1, x_2, x_3 \ldots\ldots x_n$ are n observations

Then the r^{th} moment μ_r about mean $\bar{x}$ is defined as

Remove $\longrightarrow$ f

$\Sigma f = n$(number of observation)

Moment about any arbitrary number (μ'_r)

For individual series

If $x_1, x_2, x_3 \ldots\ldots x_n$ are n observations

Then the r^{th} moment μ'_r about any Arbitrary number(A) is defined as

Remove $\longrightarrow$ f

$\Sigma f = n$

Moment about origin (ϑ_r)

For individual series

If $x_1, x_2, x_3 \ldots\ldots x_n$ are n observations

Then the r^{th} moment ϑ_r about origin(0,0) is defined as

Remove $\longrightarrow$ f

$\Sigma f = n$

Q.1 Find the first four moments for the following individual series :

x	3	6	8	10	18

Solution

S.NO	x	$(x-\bar{x})$	$(x-\bar{x})^2$	$(x-\bar{x})^3$	$(x-\bar{x})^4$
1	3	-6	36	-216	1296
2	6	-3	9	-27	81
3	8	-1	1	-1	1
4	10	1	1	1	1
5	18	9	81	729	6561
$n=5$	$\Sigma x = 45$	$\Sigma(x-\bar{x}) = 0$	$\Sigma(x-\bar{x})^2 = 128$	$\Sigma(x-\bar{x})^3 = 486$	$\Sigma(x-\bar{x})^4 = 7940$

Mean ($\bar{x}$)

$$\bar{x} = \frac{\Sigma x}{n}$$

$$\bar{x} = \frac{45}{5}$$

$$\boxed{\bar{x} = 9}$$

Moments

$$\boxed{\mu_1 = 0}$$

$$\mu_2 = \frac{\Sigma (x-\bar{x})^2}{n}$$

$$\mu_2 = \frac{128}{5}$$

$$\boxed{\mu_2 = 25.6}$$

$$\mu_3 = \frac{\Sigma (x-\bar{x})^3}{n} = \frac{486}{5}$$

$$\boxed{\mu_3 = 97.2}$$

$$\mu_4 = \frac{\Sigma (x-\bar{x})^4}{n} = \frac{7940}{5}$$

$$\boxed{\mu_4 = 1588}$$

Q.2 The number of flowers on Sun-flower plants are given below: (AKTU)

No. of flowers (x)	3	6	12	16	25
No. of plants (f)	1	2	3	4	5

Calculate the first four moments about the mean

x	f	fx	$(x-\bar{x})$	$f(x-\bar{x})$	$f(x-\bar{x})^2$	$f(x-\bar{x})^3$	$f(x-\bar{x})^4$
3	1	3	−13	−13	169	−2197	28561
6	2	12	−10	−20	200	−2000	20000
12	3	36	−4	−12	48	−192	768
16	4	64	0	0	0	0	0
25	5	125	9	45	405	3645	32805
	$\Sigma f = 15$	$\Sigma fx = 240$		$\Sigma f(x-\bar{x}) = 0$	$\Sigma f(x-\bar{x})^2 = 822$	$\Sigma f(x-\bar{x})^3 = -744$	$\Sigma f(x-\bar{x})^4 = 82134$

Mean ($\bar{x}$)

$$\bar{x} = \frac{\Sigma fx}{\Sigma f}$$

$$\bar{x} = \frac{240}{15}$$

$$\boxed{\bar{x} = 16}$$

Moments

$$\boxed{\mu_1 = 0}$$

$$\mu_2 = \frac{\Sigma f(x-\bar{x})^2}{\Sigma f}$$

$$\mu_2 = \frac{822}{15}$$

$$\boxed{\mu_2 = 54.8}$$

$$\mu_3 = \frac{\Sigma f(x-\bar{x})^3}{\Sigma f} = \frac{-744}{15}$$

$$\boxed{\mu_3 = -49.6}$$

$$\mu_4 = \frac{\Sigma f(x-\bar{x})^4}{\Sigma f} = \frac{82134}{15}$$

$$\boxed{\mu_4 = 5475.6}$$

Q.3 :- *Calculate $\mu_1, \mu_2, \mu_3, \mu_4$, for the following frequency distribution :*

Marks	5-15	15-25	25-35	35-45	45-55	55-65
No. of students (f)	10	20	25	20	15	10

MARKS	f	Mid value (x)	fx	$(x-\bar{x})$	$f(x-\bar{x})$	$f(x-\bar{x})^2$	$f(x-\bar{x})^3$	$f(x-\bar{x})^4$
5-15	10	10	100	-24	-240	5760	-138240	3317760
15-25	20	20	400	-14	-280	3920	-54880	768320
25-35	25	30	750	-4	-100	400	-1600	6400
35-45	20	40	800	6	120	720	4320	25920
45-55	15	50	750	16	240	3840	61440	983040
55-65	10	60	600	26	260	6760	175760	4569760
	$\Sigma f =$ 100		$\Sigma fx =$ 3400		$\Sigma f(x-\bar{x}) = 0$	$\Sigma f(x-\bar{x})^2 = 21400$	$\Sigma f(x-\bar{x})^3 = 46800$	$\Sigma f(x-\bar{x})^4 = 9671200$

Mean ($\bar{x}$)

$$\bar{x} = \frac{\Sigma fx}{\Sigma f}$$

$$= \frac{3400}{100}$$

$$\boxed{\bar{x} = 34}$$

Moments

$$\boxed{\mu_1 = 0}$$

$$\mu_2 = \frac{\Sigma f(x-\bar{x})^2}{\Sigma f}$$

$$\mu_2 = \frac{21400}{100}$$

$$\boxed{\mu_2 = 214}$$

$$\mu_3 = \frac{\Sigma f(x-\bar{x})^3}{\Sigma f} = \frac{46800}{100}$$

$$\boxed{\mu_3 = 468}$$

$$\mu_4 = \frac{\Sigma f(x-\bar{x})^4}{\Sigma f} = \frac{9671200}{100}$$

$$\boxed{\mu_4 = 96712}$$

DPP- 2

Topic : *Moments*

Q.1. $Calculate\ \mu_1, \mu_2, \mu_3, \mu_4, for\ the\ series : 4, 7, 10, 13, 16, 19, 22$

Q.2 *Calculate the first four moment about* $x = 15$ *and hence find the moments about the mean of the following distribution :*

x	10	11	12	13	14	15	16	17	18	19	20	21
f	9	36	75	105	116	107	88	66	45	30	18	5

Q.3 Find the first four moments about origin for the following frequency distribution:

$Marks$	0-10	10-20	20-30	30-40	40-50
$No.of\ Students$	5	10	40	20	25

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Thank You

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