Equations

Module 1

<u>Quartile</u>

Q_1, Q_2, Q_3

- for ungrouned Frequency
  [class intervals [illegible]]

$$Q_1 = \frac{N}{4}$$

$$Q_2 = \frac{2N}{4}$$

$$Q_3 = \frac{3N}{4}$$

- ~~eg~~ for grouped Frequencies
  [class intervals].

$$Q_1 = L_1 + \left(\frac{N}{4} - C\right) \times \frac{h}{f}$$

$h \rightarrow$ Class width

$f \rightarrow$ frequency of class

$C \rightarrow$ Cumilative frequency ~~above the~~ of the previous Q_1 class

$N \rightarrow$ to Sum of frequency

$L \rightarrow$ lower limit

$$Q_2 = L_1 + \left(\frac{2N}{4} - C\right) \times \frac{h}{f}$$

$$Q_3 = L_1 + \left(\frac{3N}{4} - C\right) \times \frac{h}{f}$$

Module 2

Arithematic Mean

- for raw data

$$\bar{x} = \frac{1}{N} \sum_{i=1}^{n} x$$

$N \Rightarrow$ Sum of frequency.

- for frequency

$$\bar{x} = \frac{1}{N} \sum_{i=1}^{n} x_i f_i$$

- Combined arithematic mean.

$$\bar{x} = \frac{n_1 \bar{x_1} + n_2 \bar{x_2} + \cdots + n_k \bar{x}_k}{n_1 + n_2 + n_3 + \cdots + n_k}$$

Median

- for row data / ungrouped frequency distribution

~~odd~~ $\Rightarrow$

if N is odd $\Rightarrow$ $\frac{N}{2}$ th observation

if N is even $\Rightarrow$ $\dfrac{\frac{N}{2}\text{th obs} + \frac{N}{2}+1\text{ th obse}}{2}$.

- for grouped frequency

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

$l \rightarrow$ lower limit of median class.
$f \rightarrow$ frequency of Median class.
$h \rightarrow$ class width.
$C \rightarrow$ C.f of preceeding (before) Median class.

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Mode

Mode class ⟹ Highest frequency class.

Ungrouped ⟹ x which as highest frequency

Grouped Continious frequency

$$\text{Mode} = l + \frac{h(f_1 - f_0)}{2f_1 - f_0 - f_2}$$

l - lower limit of model class

h - class width of model class

f_1 - frequency of model class

f_0 - frequency of class preceding Model class

f_2 - frequency of class succeeding Model class (after)

Geometric Mean

~~for ungrouped~~ / raw data

$$GM = (x_1 \times x_2 \cdot \cdot \cdot \times x_n)^{1/n}$$

$$\log GM = \frac{1}{N} \sum_{i=1}^{n} \log x_i$$

Grouped or ungrouped frequency

$$GM = (x_1^{f_1} \cdot x_2^{f_2} \cdot \cdot \cdot x_n^{f_n})^{1/n}$$

$$\log GM = \frac{1}{N} \sum_{i=1}^{n} f_i \log x_i$$

Module - 3

Range = Largest value - Smallest Value.

$$\text{Coefficient of Range} = \frac{L-S}{L+S}$$

L - Largest value
S - Smallest Value

Inter Quartile Range (IQR) $= Q_3 - Q_1$

$$\text{Quartile Deviation } QD = \frac{IQR}{2} = \frac{Q_3 - Q_1}{2}$$

$$\text{Coefficient of } Q.D = \frac{Q_3 - Q_1}{Q_3 + Q_1}$$

Mean deviation

1) Mean deviation from Mean. a) Row data

$$M.D(\bar{x}) = \frac{|x_1 - \bar{x}| + |x_2 - \bar{x}| + \cdots + |x_n - \bar{x}|}{N}$$

$$= \frac{1}{N} \sum_{i=1}^{n} |x_i - \bar{x}|$$

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b) frequency

$$M.D(\bar{x}) = \frac{f_1|x_1-\bar{x}| + f_2|x_2-\bar{x}| + \dots + f_n|x_n-\bar{x}|}{f_1+f_2+\dots+f_n}$$

$$= \frac{1}{N}\sum_{i=1}^{n} f_i|x_i-\bar{x}|$$

2) Mean Deviation about Mode

$$MD(M_o) = \frac{|x_1-M_o| + |x_2-M_o| + \dots + |x_n-M_o|}{N}$$

$$= \frac{1}{N}\sum_{i=1}^{n} |x_i-M_o|.$$

for frequency ;

$$MD(M_o) = \frac{f_1|x_1-M_o| + f_2|x_2-M_o| + \dots + f_n|x_n-M_o|}{N}$$

$$= \frac{1}{N}\sum_{i=1}^{n} f_i|x_i-M_o|.$$

for continuous frequency =>

$$\text{Mode} = L_1 + \frac{(f_1-f_0)}{2f_1-f_0-f_2} \times h$$

Standard Deviation (σ, SD)

- for row data

$$\sigma = \sqrt{\frac{(x_1-\bar{x})^2 + (x_2-\bar{x})^2 + \cdots + (x_n-\bar{x})^2}{n}}$$

$$\sigma = \sqrt{\frac{\sum_{i=1}^{n} (x_i-\bar{x})^2}{n}}$$

$$\sigma = \sqrt{\frac{\sum x_i^2}{n} - \bar{x}^2}$$

These three equations can be used. but 3^{rd} one is the better one to Calculate.

- for continous frequency distribution

$$SD = \sqrt{\frac{f_1(x_1-\bar{x})^2 + f_2(x_2-\bar{x})^2 + \cdots + f_n(x_n-\bar{x})^2}{f_1 + f_2 + \cdots + f_3}}$$

$$S.D. = \frac{\sum_{i=1}^{n} f_i (x_i^2)}{N} - \left(\frac{\sum f_i x_i}{N}\right)^2$$

Combined Standard Deviation

$$S.D = \sqrt{\frac{n_1\sigma_1^2 + n_2\sigma_2^2}{n_1 + n_2}}$$

Raw moments

for individual $\mu_r' = \frac{\sum_{i=1}^{n} x_i^r}{n}$

for discrete and continous
$$\mu_r' = \frac{\sum_{i=1}^{n} f_i x_i^r}{N}$$

Central Moments
for individual $\mu_r = \frac{\sum_{i=1}^{n} (x_i - \bar{x})^r}{n}$

for disirete and continous
$$\mu_r = \frac{\sum_{i=1}^{n} f_i (x_i - \bar{x})^r}{N}$$

Reccurance Relation

$$\mu_r = \mu_r' - rC_1 \mu_{r-1}' \mu_1' + rC_2 \mu_{r-2}' \mu_1'^2 + \dots + (-1)^r \mu_1'^r$$

$\mu_1 = 0$ always.

$\mu_2 = \mu_2' - (\mu_1')^2$

$\mu_3 = \mu_3' - 3\mu_2'\mu_1' + 2(\mu_1')^3$

$\mu_4 = \mu_4' - 4\mu_3'\mu_1' + 6\mu_2'(\mu_1')^2 - 3(\mu_1')^4$.

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Coefficient of Variation

$$C.V = \frac{\sigma}{\bar{x}} \times 100$$

Less C.V => more consistent

greater C.V => more variable

$$\text{Variance} = (S.D)^2$$
$$= \sigma^2$$

Module 4

Moments

individual Series $\mu_r' = \frac{\sum_{i=1}^{n} (x_i - A)^r}{n}$

Frequency $\mu_r' = \frac{\sum_{i=1}^{n} f_i (x_i - A)^r}{n}$

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Karl Pearson Coefficient of Skewness.

$$J = \frac{\text{Mean} - \text{Mode}}{S.D}$$

$$-3 < J < 3$$

Second Measure of Skewness.

$$S_B = \frac{(Q_3 - M) - (M - Q_1)}{Q_3 - Q_1} = \frac{Q_3 + Q_1 - 2M}{Q_3 - Q_1}$$

3rd Measure of Skewness.

$$S_k = \frac{D_9 - D_1 - 2\,\text{median}}{D_9 - D_1}$$

$D_9 \Rightarrow$ Decile 9.
$D_1 \Rightarrow$ Decile 1.

4th Measure of Skewness.

$$\text{Coefficient of Skewness} = \frac{\mu_3}{\sqrt{\mu_2^3}}$$

Measure of Kurtosis

$$\beta_2 = \mu_4 / \mu_2^2.$$

$\beta_2 = 3 \Rightarrow$ curve is mesokurtic
$\beta_2 < 3 \Rightarrow$ curve is platykurtic
$\beta_2 > 2. \Rightarrow$ curve is leptokurtic

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Skewness (S) = $\frac{\text{Mean} - \text{Mode}}{\text{SD}}$

Mode = 3 Median − 2 mean.