

غير مسموح بتصوير هذه النواتات

Fall 2017

إلا من خلال معهد GSI

م / محمد يونس 51111845



Statistics I – IE 230

Lecture 01

م . محمد يونس



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Basic Mechanics ME 270 & ME 274 – Mechanics of Material NUCL 273 & ME 323

Thermodynamics ME200/ENGR 200 – Statistics IE 230 & IE 330 – Quality Control IE 530 – Operations Research IE 335

Q1) given the following Data:-

33, 42, 74, 60, 85, 70, 42, 55, 42, 88, 42, 42, 42, 480, 1

Solution

After ordering

1, 33, 42, 42, 42, 42, 42, 42, 55, 60, 70, 74, 85, 88, 480

تمرين مع ترتيب

Calculate:-

1. No of data $n = 15$

2. Degree of freedom $df = v = n - 1 = 14$

3. Min & max values $X_{\max} = 480$
 $X_{\min} = 1$

4. Range $R = X_{\max} - X_{\min}$

$$R = 480 - 1 = 479$$

5. Mode

$$\text{Mode} = 42$$

Repeated 6 times

6. Mean = Average

2

$$\bar{X} = \frac{\sum X_i}{n} = \frac{1198}{15} = 79.9$$

7. Variance = s^2 → variability = variation

mean ناتج

squared
ع.م

No	X_i	$X_i - \bar{X}$	$(X_i - \bar{X})^2$
1	1	-78.9	6225.21
2	33	-46.9	2199.61
3	42	-37.9	1436.41
4	42	-37.9	1436.41
5	42	-37.9	1436.41
6	42	-37.9	1436.41
7	42	-37.9	1436.41
8	42	-37.9	1436.41
9	55	-24.9	620.01
10	60	-19.9	396.01
11	70	-9.9	98.01
12	74	-5.9	34.81
13	85	5.1	26.01
14	88	8.1	65.61
15	480	400.1	160080
Total	1198	-----	178363.8

← sum

$$s^2 = \frac{\sum (X_i - \bar{X})^2}{n-1} = \frac{178363.8}{14} = 12740.3$$

$$s = \sqrt{12740.3} = 112.87$$

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Other method

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No	X _i	X ²
1	1	1
2	33	1089
3	42	1764
4	42	1764
5	42	1764
6	42	1764
7	42	1764
8	42	1764
9	55	3025
10	60	3600
11	70	4900
12	74	5476
13	85	7225
14	88	7744
15	480	230400
Total	1198	274044

$$s^2 = \frac{1}{n-1} \left[\sum x_i^2 - \frac{(\sum x_i)^2}{n} \right]$$

$$s^2 = \frac{1}{14} \left[(274044) - \frac{(1198)^2}{15} \right] = 12734.3$$

8. Standard Deviation = $s = \sqrt{\text{Variance}}$

$$s = \sqrt{12734.3} = 112.87$$

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9. Median = Second Quartile = $\tilde{X} = Q_2 = 9_2$

4

① $n = 15$ odd - فردی

$$\frac{15+1}{2} = 8 \rightarrow \text{location}$$

$$\tilde{X} = Q_2 = X_8 = 42$$

② If n even زوجی

example

2, 3, 7, 20, 100, 150

$$n = 6$$

$$\frac{6}{2} = 3 \rightarrow X_3$$

$$Q_2 = \tilde{X} = \frac{X_3 + X_4}{2} = \frac{7 + 20}{2} = 13.5$$

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10. First Quartile = Lower Quartile = $Q_1 = Q_L$

5

① location $\frac{1}{4}(n+1)$

$$\frac{1}{4}(15+1) = 4$$

4 ملک

$$Q_1 = 42$$

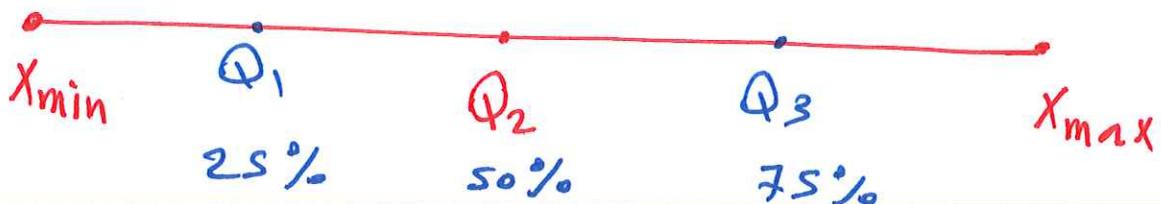
11. Third Quartile = Upper Quartile = $Q_3 = Q_U$

① location $\frac{3}{4}(n+1)$

$$\frac{3}{4}(15+1) = 12$$

② magnitude $Q_3 = 74$

Five descriptive statistics = five summary data



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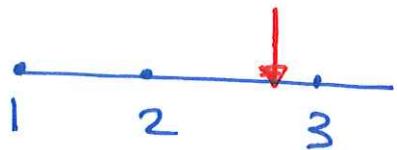
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example (ex)

6

2, 3, 7, 8, 11, 15, 17, 20, 25, 30

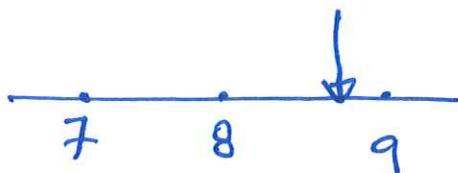
$$Q_1 \rightarrow \frac{1}{4}(10+1) = 2.75$$



$$Q_1 = \frac{x_2 + x_3}{2} = \frac{3 + 7}{2} = 5$$

$Q_1 = 5$ → magnitude

$$Q_3 \rightarrow \frac{3}{4}(10+1) = 8.25 \rightarrow \text{location}$$



$$Q_3 = \frac{20 + 25}{2} = 22.5$$

$Q_3 = 22.5$

12. Inter Quartile Range = IQR

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$$IQR = Q_3 - Q_1$$

$$IQR = 74 - 42$$

$$IQR = 32$$

13. Check for outliers

$$L_{\min} = C_{\min} = Q_1 - 1.5 IQR = 42 - 1.5(32)$$

$$L_{\max} = C_{\max} = Q_3 + 1.5 IQR = 74 + 1.5(32)$$

$$\text{---} \downarrow \quad \downarrow \text{---}$$
$$L_{\min} = -6 \quad \therefore 480 \text{ outlier} \quad L_{\max} = 122$$

14. Check for extreme outliers

$$L_{\min} = C_{\min} = Q_1 - 3 IQR = 42 - (3 \times 32) = -54$$

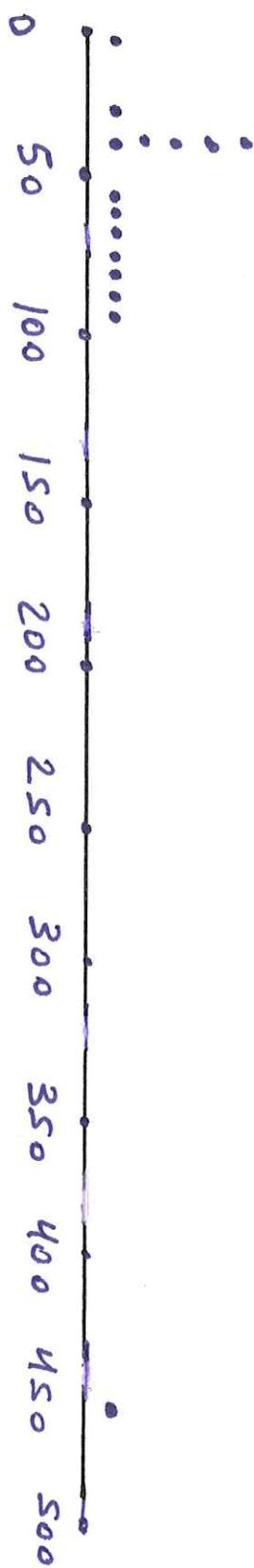
$$L_{\max} = C_{\max} = Q_3 + 3 IQR = 74 + (3 \times 32) = 170$$

$$\text{---} \bullet \quad \bullet \text{---}$$
$$L_{\min} = -54 \quad L_{\max} = 170$$

480 is extreme outlier

15. Construct a Dot Plot

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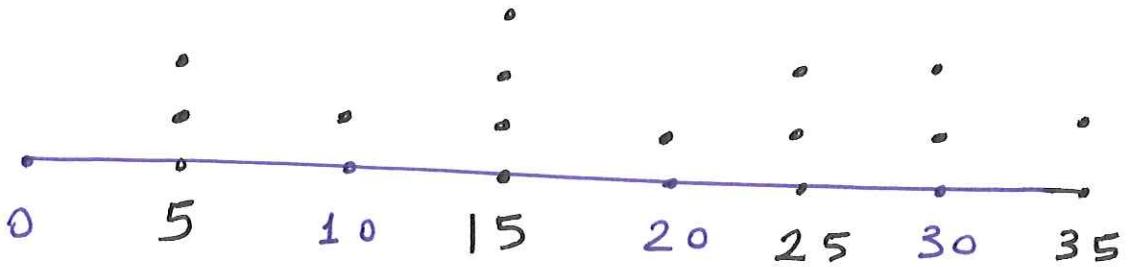


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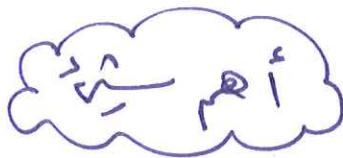
example



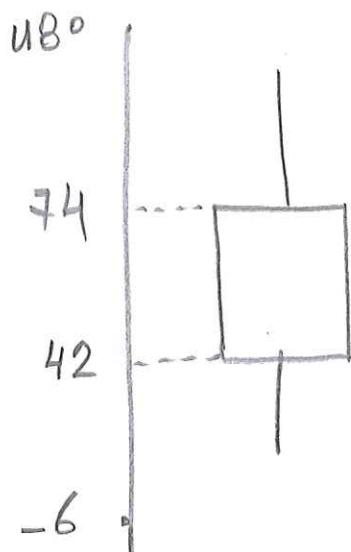
1) Find \bar{x} and s^2

5, 5, 10, 15, 15, 15, 20, 25, 25, 30, 30, 35

16. Box Plot



10



$$X_{\min} = 1$$

$$X_{\max} = 480$$

$$Q_1 = 42$$

$$Q_2 = 42$$

$$Q_3 = 74$$

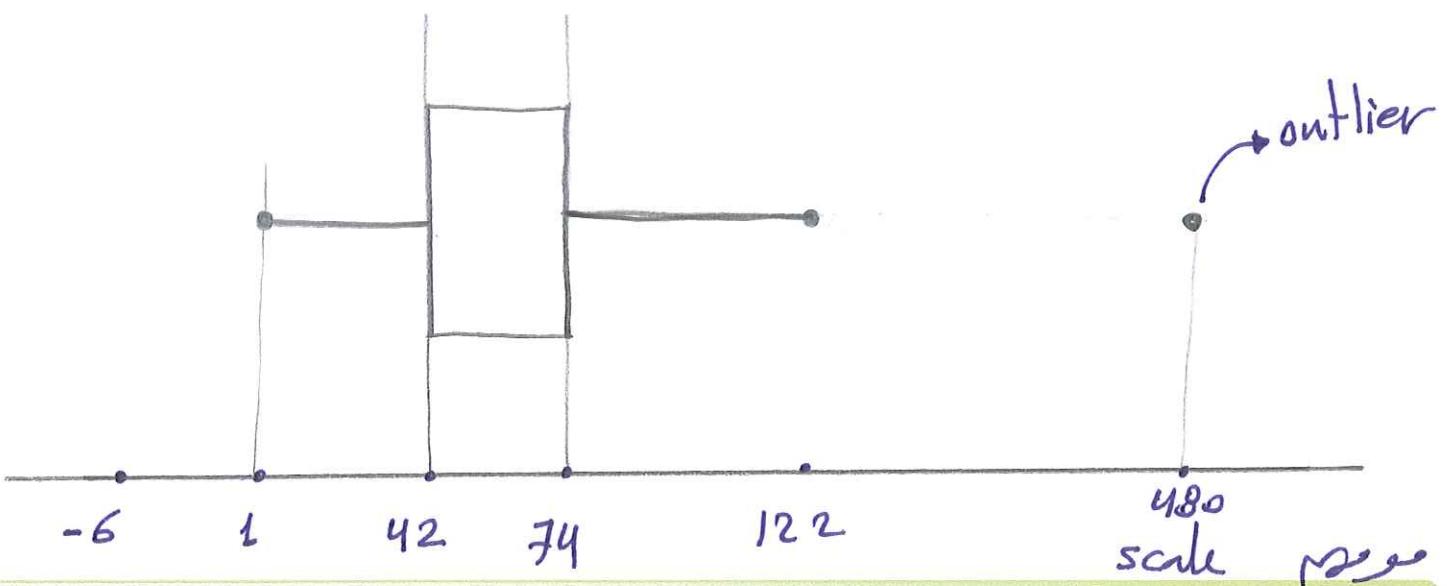
$$Q_1 - 1.5 \text{ IQR} = -6$$

$$Q_3 + 1.5 \text{ IQR} = 122$$

برط أنم اخط نا يجاور

Limit L_{min}
 L_{max}

$\left\{ \begin{array}{l} X_{\min} \text{ و } Q_1 \text{ مطابقان} \\ X_{\max} \text{ و } Q_3 \text{ مطابقان} \end{array} \right.$



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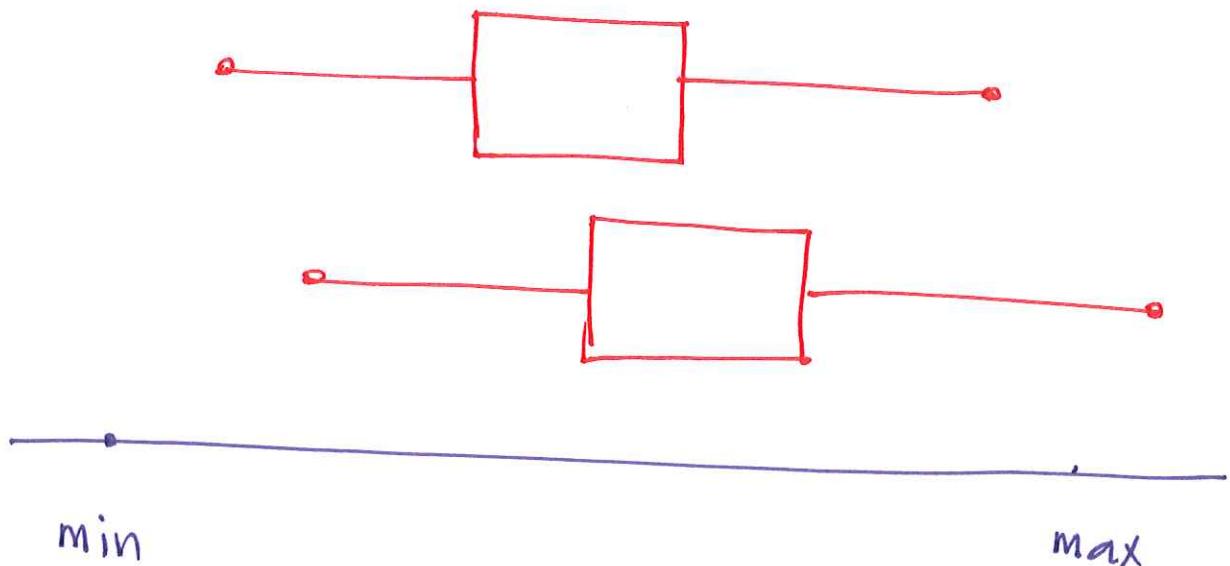
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example

Male	160	162	165	150	170	180
Female	155	159	161	172	158	159

* Draw comparative box plot

لارزم تکل
منه خبی
 $x_{\min}, x_{\max}, Q_1, Q_2, Q_3$



Q2) given the following Data:-

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2, 32, 36, 44, 52, 41, 40, 9, 39, 56, 65, 64, 64, 60, 61, 71, 17, 18,
90, 100, 16, 18, 22, 79, 109, 81, 82, 63, 55, 60, 12, 11, 13, 36, 45,
58, 71, 92, 99

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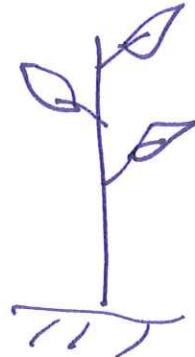
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أورام

1. Construct Stem and Leaf Diagram

SL 82 → 8 2
 2 → 0 2
 20 → 2 0
 135 → 1 35
 or → 13 5



13

stem	Leaf	Frequency
0	2 9	2
1	1 2 3 6 7 8 8	7
2	2	1
3	2 6 6 9	4
4	0 1 4 5	4
5	2 5 5 8	4
6	0 0 1 3 4 4 5	7
7	1 1 9	3
8	1 2	2
9	0 2 9	3
10	0 9	2
also		39 (total)
$\hat{X} = 20 \rightarrow \frac{39+1}{2} = 20$		median القيمة الوسطى
$\hat{X} = 55$ magnitude		

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2. Construct Frequency Table

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① $K = \text{number of bins} = \text{number of intervals}$

$$K = \sqrt{n} = \sqrt{39} = 6.24$$

$2+18 \rightarrow \frac{x}{n} \times 100\%$

$$K \approx 6$$

Interval (class)	Frequency (X)	Relative Frequency	Cumulative Frequency	Cum. Relative Freq
$2 \leq X < 20$	9	23.2%	9	23.2%
$20 \leq X < 38$	4	$\frac{4}{39} \times 100 = 10.2$ 10.2%	$9+4=13$ 13	33.4%
$38 \leq X < 56$	7	18.0%	20	51.4%
$56 \leq X < 74$	11	28.2%	31	79.6%
$74 \leq X < 92$	4	10.2%	35	89.8%
$92 \leq X < 110$	4	10.2%	39	100%
Total	39	100%	(39)	

$$② w = \text{bin width} = \frac{R}{K} = \frac{x_{\max} - x_{\min}}{6}$$

$$w = \frac{109 - 2}{6} = 17.8$$

$$w \approx 18$$

نسبة كل جدول معنوية تدعى x_{\min} x_{\max} w \equiv $w = \frac{x_{\max} - x_{\min}}{K}$

$$K = \frac{R}{w}$$

width \equiv $w = \frac{x_{\max} - x_{\min}}{K}$

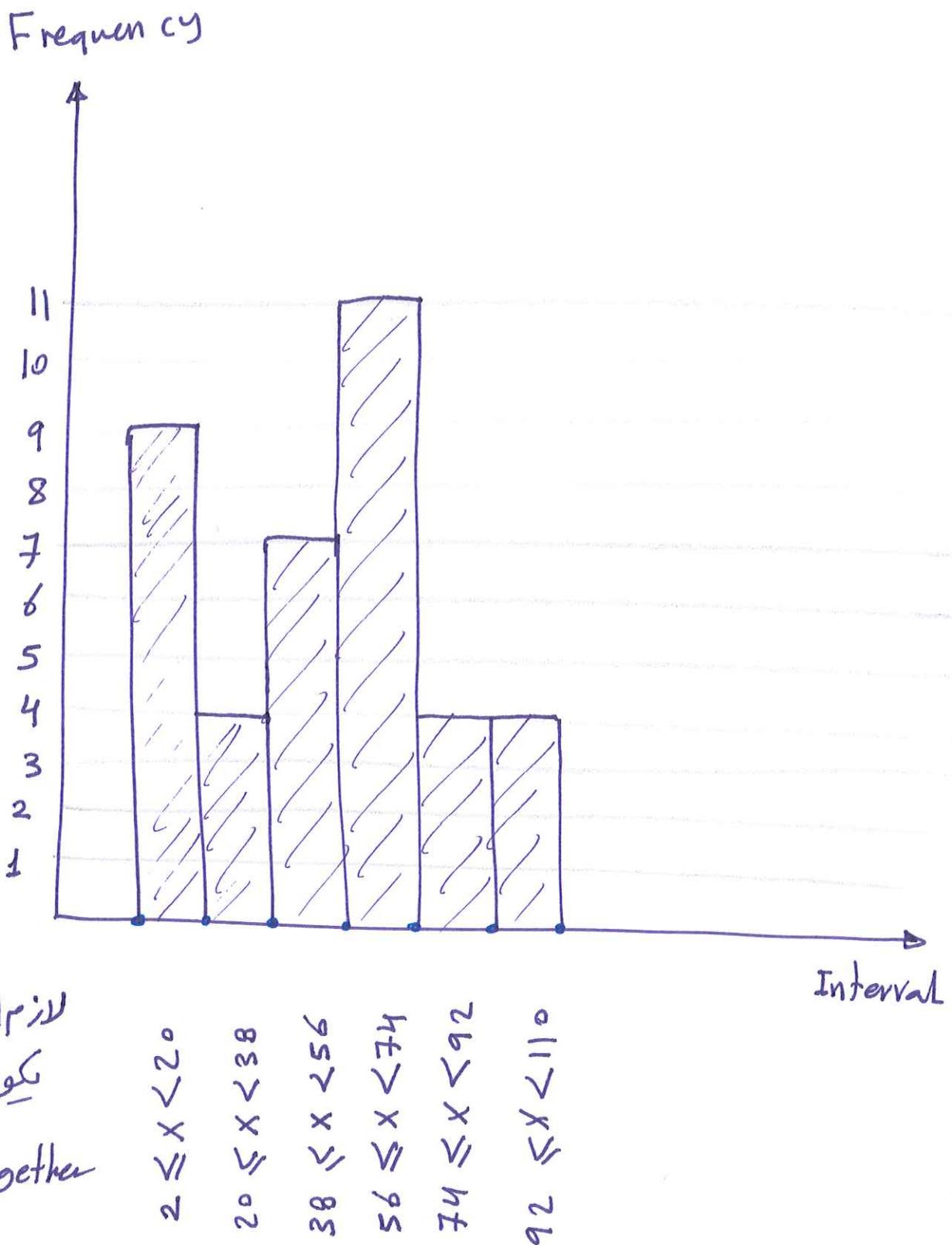
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3. Construct Histogram

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4. Construct Pareto Chart

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always include these 4 in pareto chart.

pie chart line

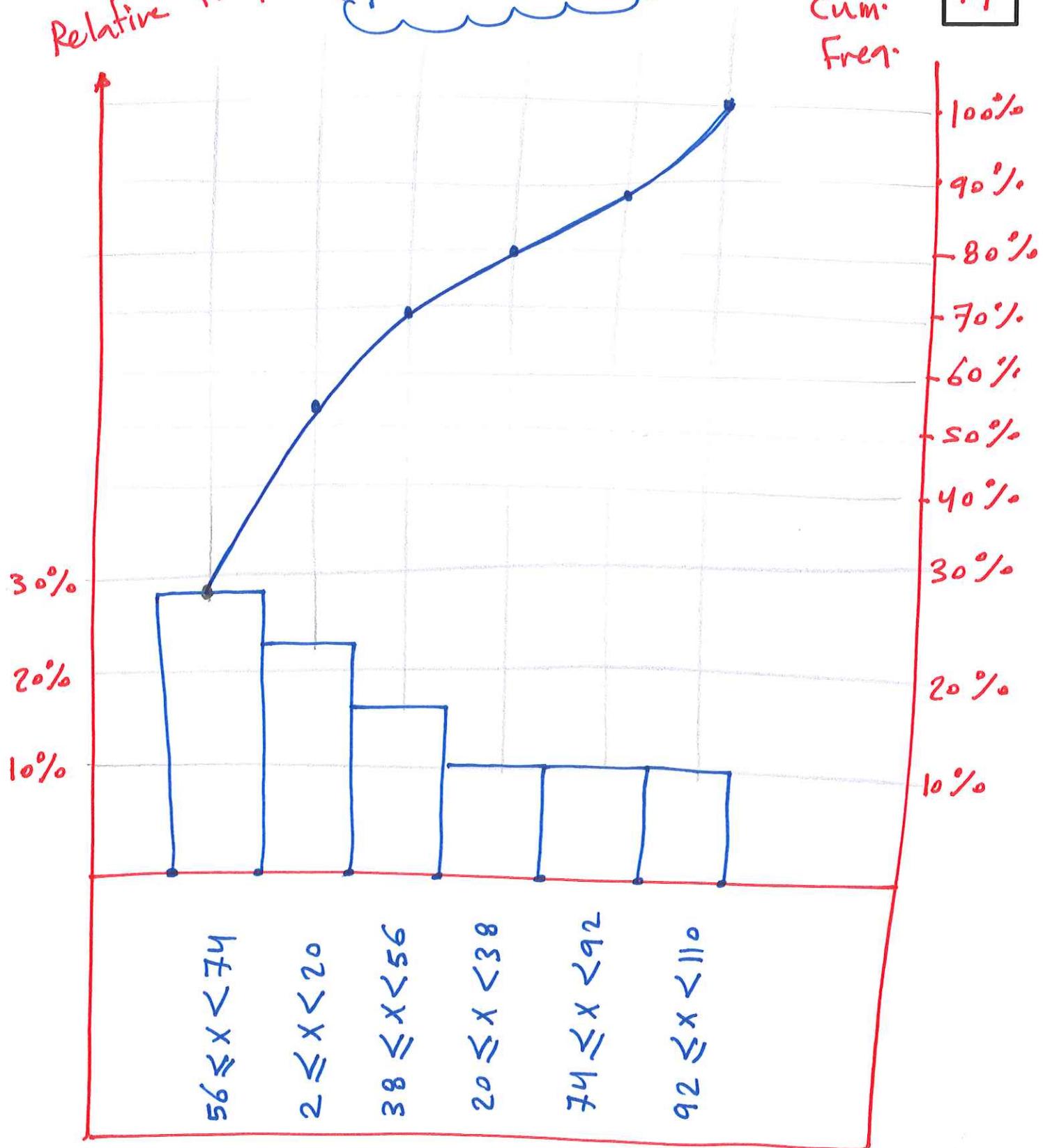
Interval	ordered Frequency	Relative Frequency	Cummulative Relative Freq.
$56 \leq x < 74$	11	28.2%	28.2%
$2 \leq x < 20$	9	23.2%	51.4%
$38 \leq x < 56$	7	18%	69.4%
$20 \leq x < 38$	4	10.2%	79.6%
$74 \leq x < 92$	4	10.2%	89.8%
$92 \leq x < 110$	4	10.2%	100%

Relative Freq.

Pareto chart

Cum. Freq.

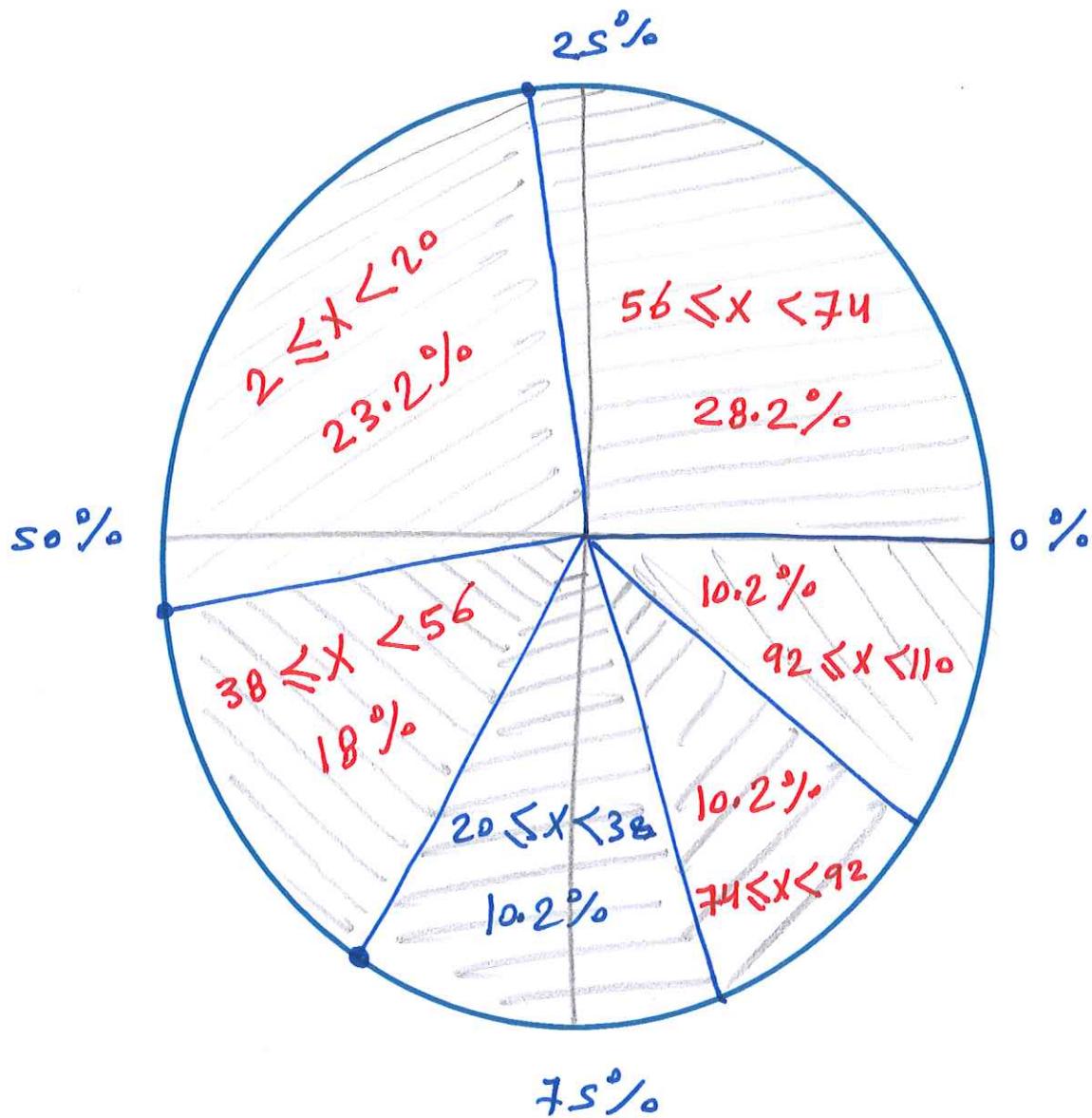
17



5. Construct Pie Chart

18

We draw Pie chart from pareto table
(Cumulative Relative frequency ordered)



skewness

19

Given data

*

20, 30, 31, 33, 90, 102, 110, 115

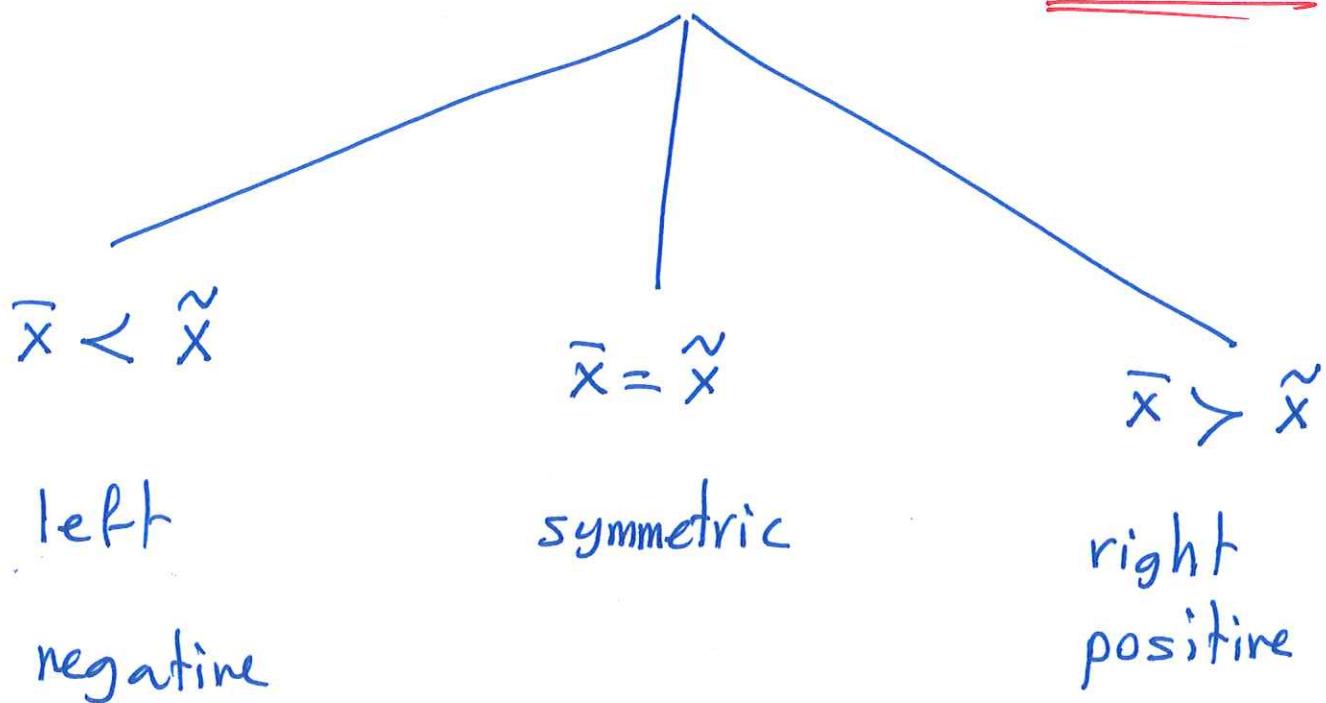
check skewness of the data

① calculate mean = $\bar{x} = 66.4$

② ✓ median = $\tilde{x} = Q_2 = 61.5$

③ compare

$\bar{x} > \tilde{x}$ right (positive) skewness



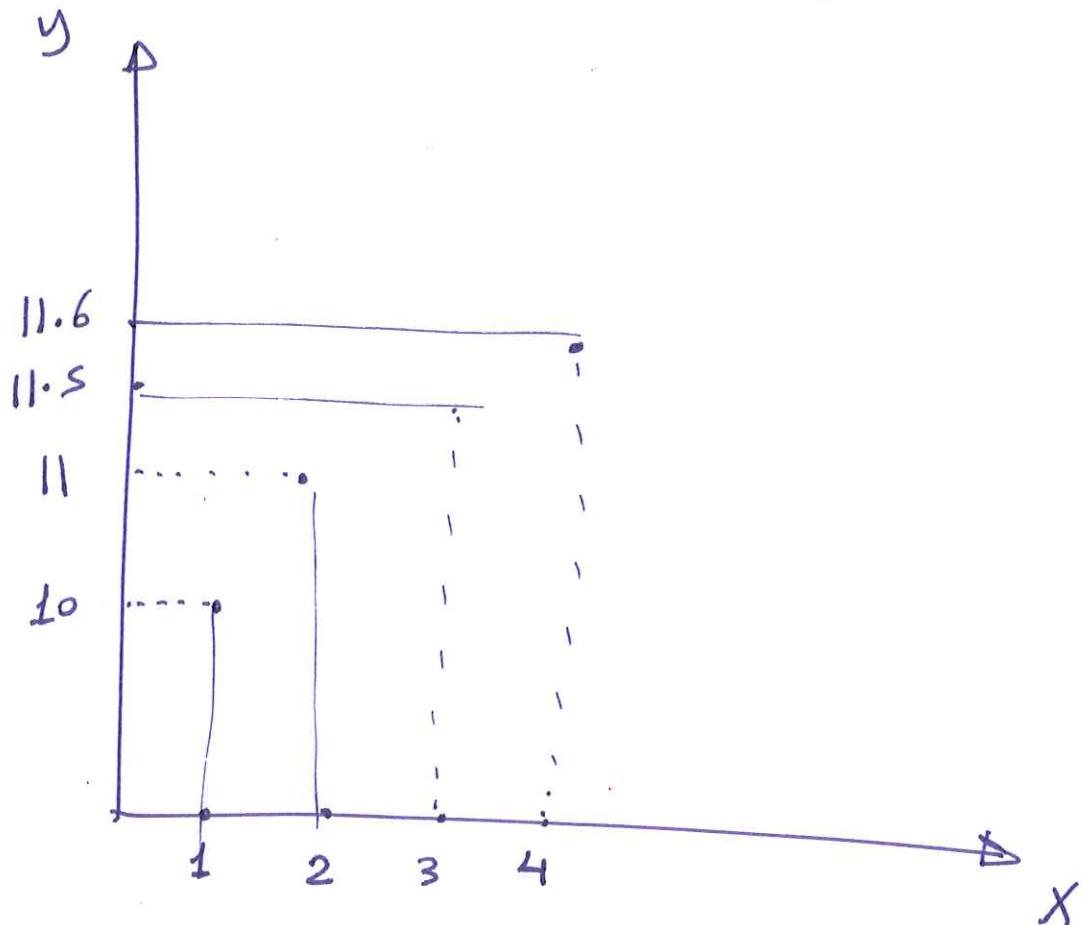
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* Correlation = r

دلي



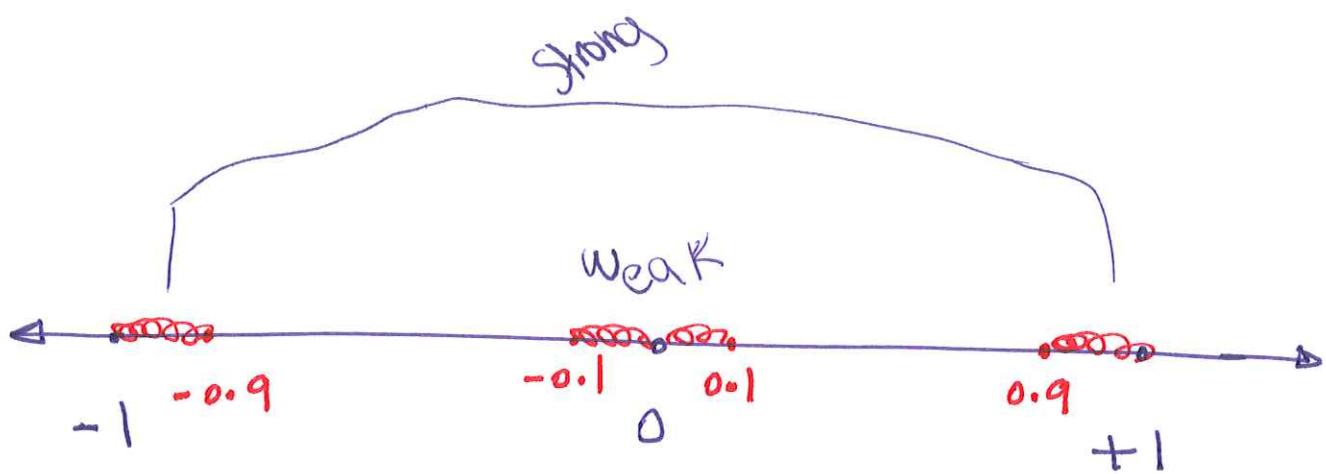
$X \rightarrow$ increases

$Y \rightarrow$ increases

r

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$$-1 \leq r \leq +1$$



$r = 0 \rightarrow \text{No correlation}$

$r = +ve \quad \text{positive correlation}$

$x \uparrow \quad y \uparrow$

$x \downarrow \quad y \downarrow$

$r = -ve \quad \text{negative correlation}$

$x \uparrow \quad y \downarrow$

$x \downarrow \quad y \uparrow$

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$r \rightarrow$ close to +1 or -1

strong correlation

$x \rightarrow$ change

$y \rightarrow$ change extremely

$r \rightarrow$ close to zero

weak correlation

$x \rightarrow$ change

$y \rightarrow$ change slowly

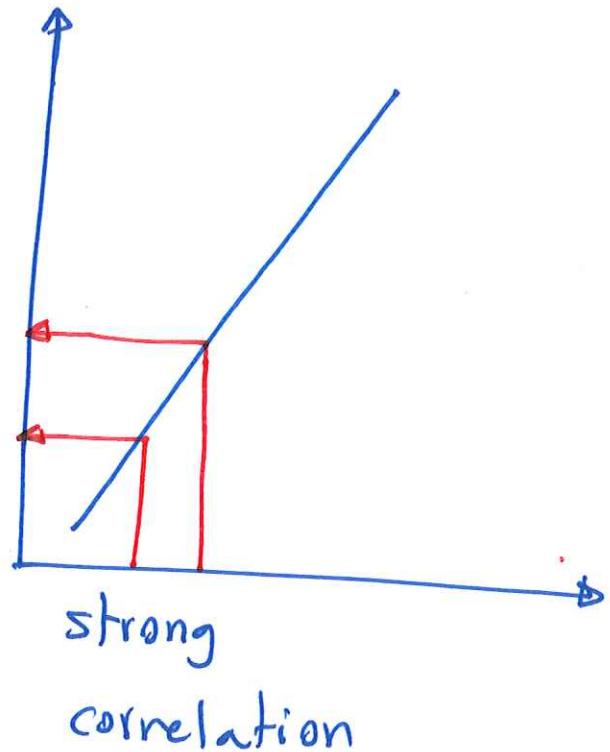
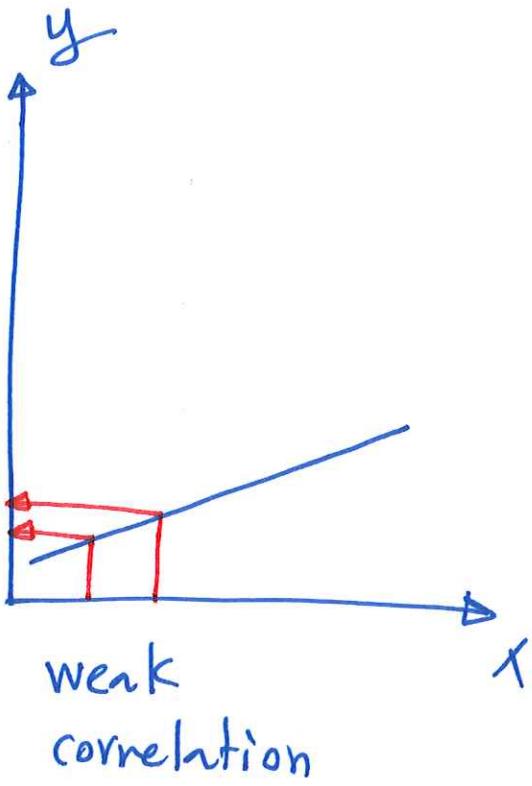
$r = 0 \rightarrow$ No correlation

$r = +0.95 \rightarrow$ strong positive $x \uparrow y \uparrow \uparrow$

$r = -0.95 \rightarrow$ strong negative $x \uparrow y \downarrow \downarrow$

$r = +0.1 \rightarrow$ positive weak $x \uparrow \uparrow y \uparrow$

$r = -0.1 \rightarrow$ negative weak $x \uparrow \uparrow y \downarrow$



correlation

strong

moderate

weak

No

$$0.7 \leq R \leq 1$$

$$0.3 \leq R \leq 0.7$$

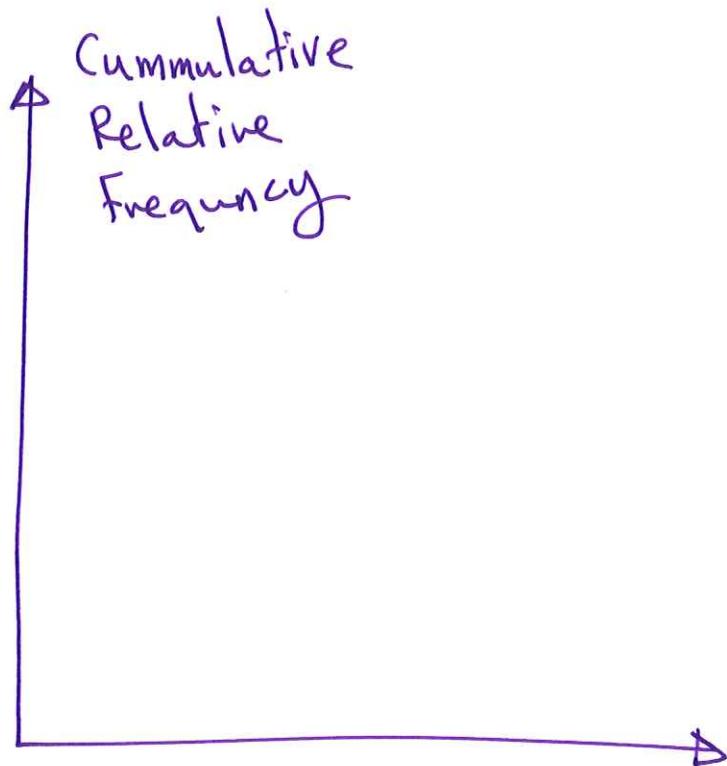
$$0 \leq R \leq 0.3$$

$$R \leq 0$$

$$-1 \leq R \leq 0.7$$

$$-0.7 \leq R \leq -0.3$$

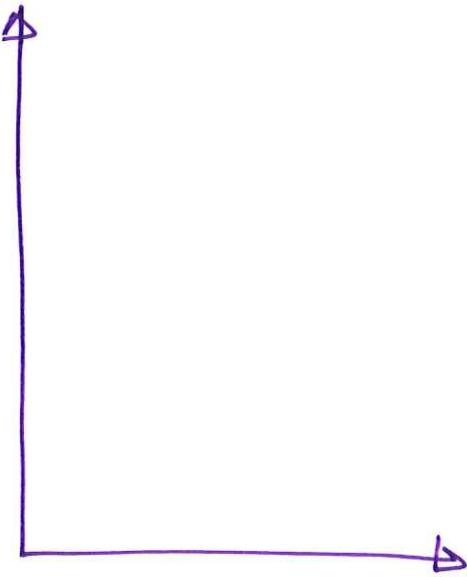
$$-0.3 \leq R \leq 0$$





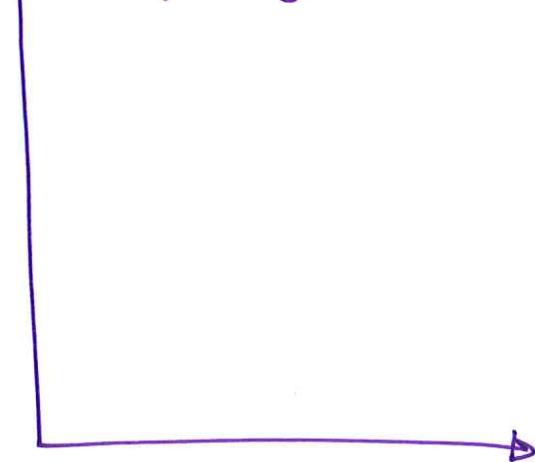
Histogram

Relative



↑ percentage
relative

↑ Frequency



Cummulative
Frequency

