# Statistics

# Lecture 3

Feb 19-8:47 AM

Complete the chart below

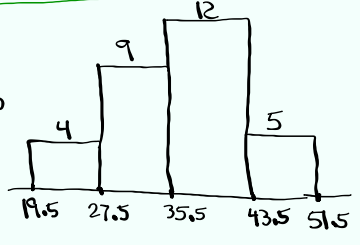
| Class limits | Class BNDRS | Class MP | Class F | Cum. F | Rel. F | % F |
|---|---|---|---|---|---|---|
| 20 - 27 | 19.5 - 27.5 | 23.5 | 4 | 4 | .133 | 13.3% |
| 28 - 35 | 27.5 - 35.5 | 31.5 | 9 | 13 | .300 | 30.0% |
| 36 - 43 | 35.5 - 43.5 | 39.5 | 12 | 25 | .400 | 40.0% |
| 44 - 51 | 43.5 - 51.5 | 47.5 | 5 | 30 | .167 | 16.7% |

27 — 27.5 — 28, CW = 8

Class MP = $\frac{\text{+ class limits}}{2}$

$n = 30$ $\quad$ Rel. F = $\frac{f}{n} = \frac{f}{30}$

Histogram
- Class BNDRS
- Class F

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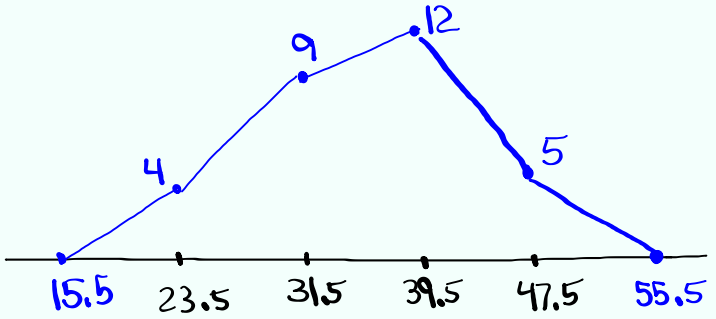
Freq. Polygon

- Class MP
- Class F




What % of Sample are between 28 & 43?

30% + 40% = 70%

from table

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n → Sample Size

SE 5-8

x → Data elements

$\sum x$ → Sum of data elements

↑ Summation

$\bar{x}$ → x-bar → Sample Mean (Average)

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

$\bar{x} = \frac{\sum x}{n} = \frac{20}{5} = \boxed{4}$

ex: Consider the Sample below

1, 3, 3, 3, 10

$n = 5$

$\sum x = 1+3+3+3+10 = \boxed{20}$

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Consider the Sample below

1 3 3 3

5 5 5 15

1) $n = 8$

2) Range $= 15 - 1 = 14$

3) Midrange $= \frac{15+1}{2} = 8$

4) Mode $= 3$ & $5$

5) Class width for 2 classes.

$\frac{\text{Range}}{2} = \frac{14}{2} = 7$ (8)

6) Class width for 3 classes.

$\frac{\text{Range}}{3} = \frac{14}{3} = 4.\overline{6}$ (5)

7) $\sum x = 1 + 3 + 3 + 3 + 5 + 5 + 5 + 15 = \boxed{40}$

8) $\bar{x} = \frac{\sum x}{n} = \frac{40}{8} = \boxed{5}$

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$x \rightarrow$ Data element

$n \rightarrow$ Sample Size

$\sum x \rightarrow$ Sum of data elements

$\bar{x} \rightarrow x$-bar $\rightarrow$ Sample Mean

$x^2 \rightarrow$ Square every data elements

$\sum x^2 \rightarrow$ Square data elements, then add

$s^2 \rightarrow$ Sample Variance

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

$s^2 = \frac{\sum (x - \bar{x})^2}{n-1} \Leftrightarrow s^2 = \frac{n\sum x^2 - (\sum x)^2}{n(n-1)}$

Consider the Sample below

2 3 3 3 9

$n = \boxed{5}$

$\sum x = 2 + 3 + 3 + 3 + 9 = \boxed{20}$

$\sum x^2 = 2^2 + 3^2 + 3^2 + 3^2 + 9^2 = \boxed{112}$

$\bar{x} = \frac{\sum x}{n} = \frac{20}{5} = \boxed{4}$

$s^2 = \frac{n\sum x^2 - (\sum x)^2}{n(n-1)} = \frac{5 \cdot 112 - 20^2}{5(5-1)} = \frac{160}{20} = \boxed{8}$

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Consider the Sample below

2 3 3 3
5 8 9 10

1) $n = 8$

2) Range $= 10 - 2 = 8$

3) Midrange $= \frac{10+2}{2} = 6$

4) Mode $= 3$

5) $\Sigma x = 2+3+3+3+5+8+9+10 = \boxed{43}$

6) $\bar{x} = \frac{\Sigma x}{n} = \frac{43}{8} = \boxed{5.375}$

7) $\Sigma x^2 = 2^2+3^2+3^2+3^2+5^2+8^2+9^2+10^2 = \boxed{301}$

Round to

| | |
|---|---|
| whole | 5 |
| 1-dec. | 5.4 |
| 2-dec. | 5.38 |

8) $S^2 = \frac{n\Sigma x^2 - (\Sigma x)^2}{n(n-1)} = \frac{8 \cdot 301 - 43^2}{8(8-1)} = \frac{559}{56} \approx \boxed{9.982}$

Round to

| | |
|---|---|
| whole | 10 |
| 1-dec. | 10.0 |
| 2-dec. | 9.98 |

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$\bar{x}$ → Sample Mean

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

$S^2$ → Sample Variance

$$S^2 = \frac{\Sigma (x-\bar{x})^2}{n-1} \quad \text{OR} \quad S^2 = \frac{n\Sigma x^2 - (\Sigma x)^2}{n(n-1)}$$

$S$ → Sample Standard deviation

$$S = \sqrt{S^2}$$

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Consider the Sample below

3 5 7 9 11

1) $n = 5$

2) Range $= 8$

3) Midrange $= 7$

4) Mode = None

5) $\Sigma x = 35$

6) $\Sigma x^2 = 285$

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

$= \frac{35}{5} = \boxed{7}$

8) $s^2 = \frac{n\Sigma x^2 - (\Sigma x)^2}{n(n-1)}$

$= \frac{5 \cdot 285 - 35^2}{5(5-1)}$

$= \frac{200}{20} = \boxed{10}$

9) $s = \sqrt{s^2}$

$= \sqrt{10} \approx \boxed{3.162}$

whole → 3

1-dec. → 3.2

2-dec. → 3.16

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Given $n = 8$, $\Sigma x = 64$, $\Sigma x^2 = 512$

Find

1) $\bar{x} = \frac{\Sigma x}{n} = \frac{64}{8} = \boxed{8}$

2) $s^2 = \frac{n\Sigma x^2 - (\Sigma x)^2}{n(n-1)}$

$= \frac{8 \cdot 512 - 64^2}{8(8-1)}$

$= \frac{0}{56} = \boxed{0}$

3) $s = \sqrt{s^2} = \sqrt{0} = \boxed{0}$

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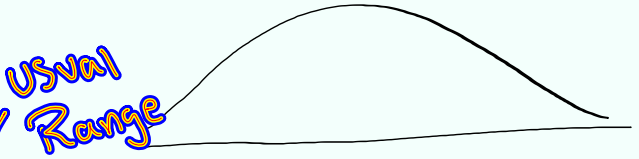
When mean, mode, and median are all the same, data distribution will be symmetric & Bell-Shape looking



Usual Range

Empirical Rule:

About 68% of data fall within $\bar{x} \pm s$.

About 95% of data fall within $\bar{x} \pm 2s$

About 99.7% " " " " $\bar{x} \pm 3s$

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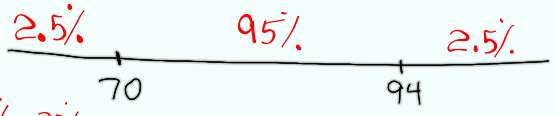
I randomly selected 200 exams, Scores were bell-Shape looking with $\bar{x}=82$ & $s=6$.

By Empirical Rule

68% Range $\Rightarrow \bar{x} \pm s = 82 \pm 6 \Rightarrow$ 76 to 88

95% Range $\Rightarrow \bar{x} \pm 2s = 82 \pm 2(6) \Rightarrow$ 70 to 94

Usual Range




100% - 68% = 32%

32% ÷ 2 = 16%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Salaries of nurses has a bell-shape dist. with $\bar{x} = \$6200/\text{mo.}$ & $S = \$350/\text{mo.}$

By Empirical Rule

68% Range $\Rightarrow \bar{x} \pm S = 6200 \pm 350$

$\Rightarrow$ 5850 To 6550

Usual Range $\Rightarrow \bar{x} \pm 2S$

95% Range $= 6200 \pm 2(350)$

$= 6200 \pm 700$

$\Rightarrow$ 5500 to 6900

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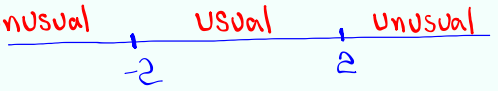
## $Z$ Score

Always round to 3-decimal places

If $-2 \le Z \le 2 \Rightarrow$ data element is usual.

If $Z < -2$ OR $Z > 2 \Rightarrow$ data element is unusual.




How to find $Z$ Score:

$$Z = \frac{x - \bar{x}}{S}$$

$Z$ Score is a method to standardize data elements.

To Compare data elements from different, we use $Z$-Scores.

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Jose got 85 on exam 1, and 78 on exam 2.

Exam 1: $\bar{x}=80$, $S=8$ $\quad Z=\frac{x-\bar{x}}{S}=\frac{85-80}{8}$

$=\boxed{.625}$

$-2\le Z\le 2$ Score was usual.

Exam 2: $\bar{x}=70$, $S=2$

$Z=\frac{x-\bar{x}}{S}=\frac{78-70}{2}=4$ $\quad Z>2$ Score was unusual.

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Lisa makes \$6500/mo. as a nurse.

Mark makes \$4500/mo. as a Sales person.

Nurse: $\bar{x}=6000$, $S=500$

Sales: $\bar{x}=4000$, $S=500$

Mark $Z=\frac{x-\bar{x}}{S}=\frac{4500-4000}{500}$

$=1$

Lisa

$Z=\frac{x-\bar{x}}{S}$

$=\frac{6500-600}{500}$

$=1$

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I randomly Selected 20 exams, here are the Scores

| | | | | |
|---|---|---|---|---|
| 52 | 58 | 64 | 66 | 69 |
| 70 | 72 | 73 | 75 | 78 |
| 82 | 84 | 84 | 86 | 88 |
| 89 | 92 | 96 | 99 | 100 |

STEM plot (Data must be Sorted)

| | |
|---|---|
| 5 | 2 8 |
| 6 | 4 6 9 |
| 7 | 0 2 3 5 8 |
| 8 | 2 4 4 6 8 9 |
| 9 | 2 6 9 |
| 10 | 0 |

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40 exams had a mean of 84 and Standard dev. 7.

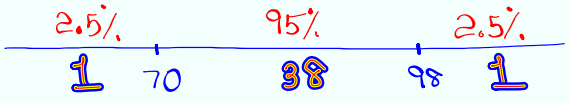
use empirical rule

1) Usual Range $\Rightarrow \bar{x} \pm 2s$

95% Range

$84 \pm 2(7) = 84 \pm 14$

$\Rightarrow$ 70 to 98




what % of Score are above 70? 97.5%

How many Scores were usual Scores?

95% of them are usual

95% (40) = 38

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