# Chapter 4: Measures of Location

## Part-1

# Learning Outcomes

After Completing the chapter ,you will able to :

- Compute the different types of measures of location.
- Understand the applications of different types of measures of location.
- Box plot and construction process of box plot.

# Contents

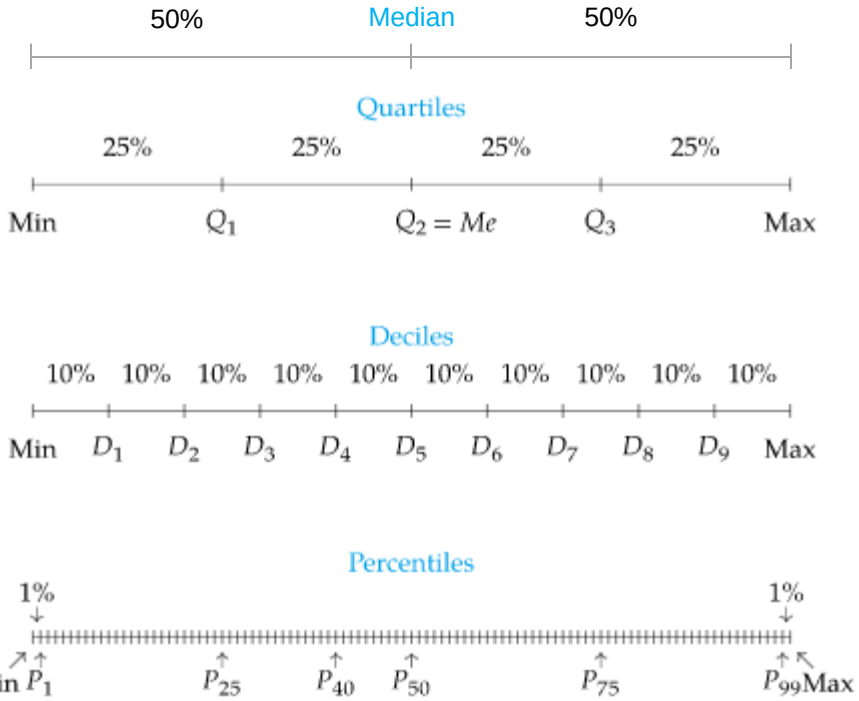
## From this lecture, you are going to learn…

- Types of Measures of location.
- Computation of Quartile, Decile and Percentile.

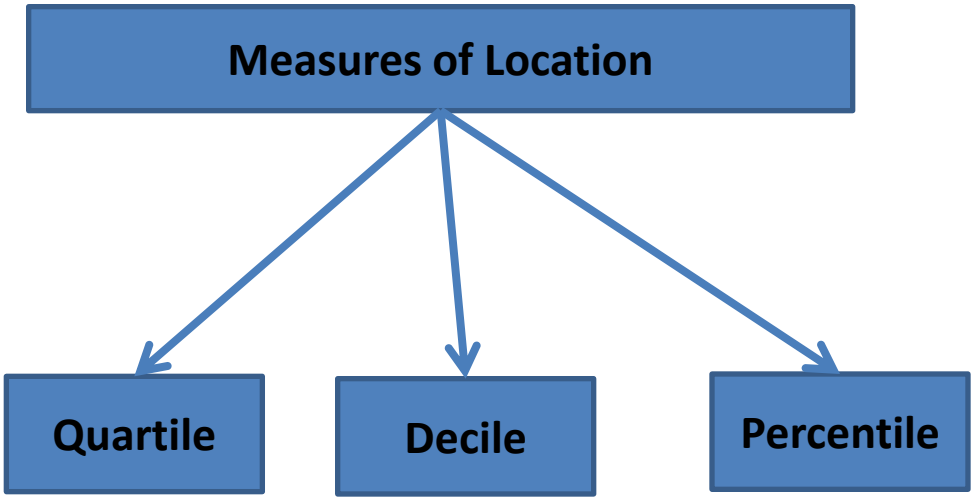
# Measures of location

We have learned that the median divides a set of data into two equal parts.

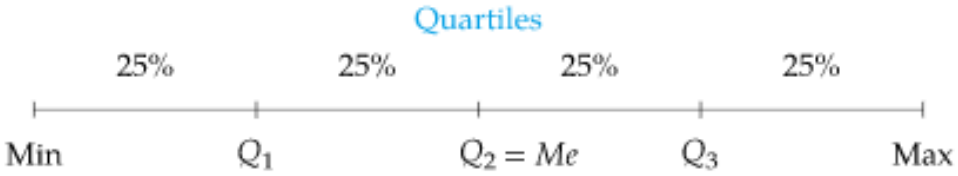
In the same way, there are also certain other values which divide a set of data into four, ten or hundred equal parts.



# Types of Measures of location



# Quartiles

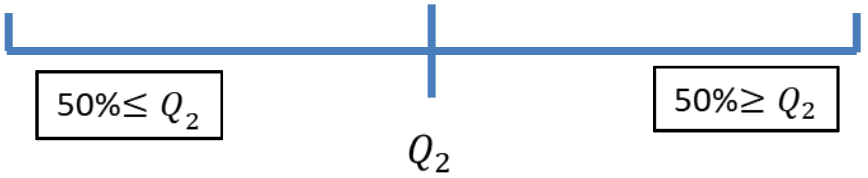



To divide the data set into 4 equal parts , 3 points are needed. These points are called quartiles.

# Quartile

1st Quartile, $Q_1$

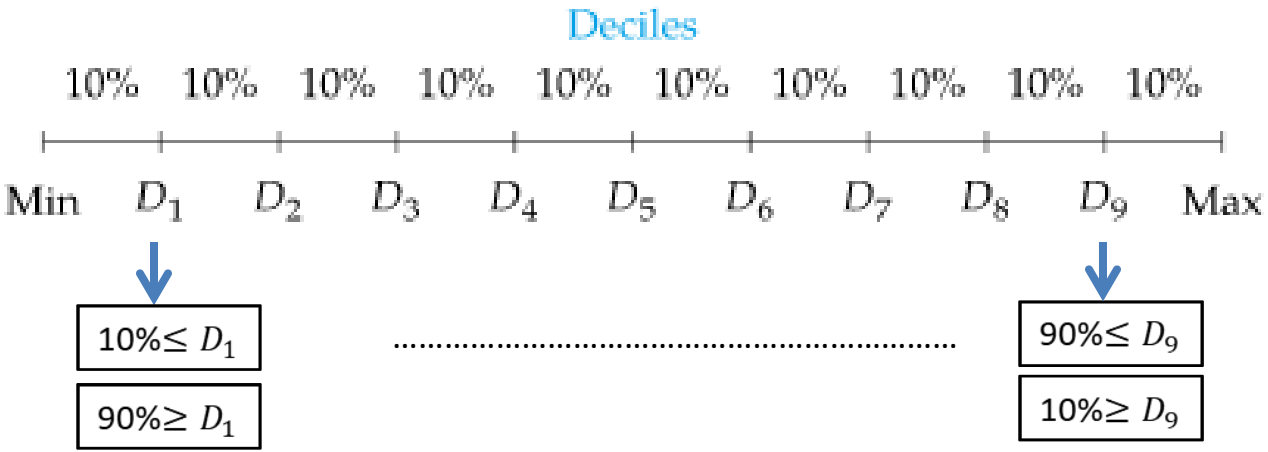

2nd Quartile, $Q_2$




3rd Quartile, $Q_3$

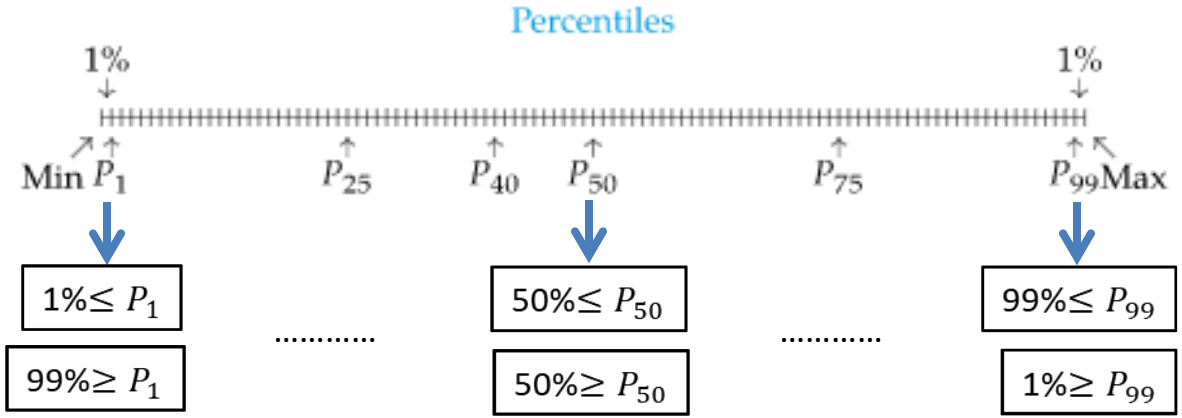
# Deciles

To divide the data set into 10 equal parts , 9 points are needed. These points are called Deciles.



# Percentile

To divide the data set into 100 equal parts , 99 points are needed. These points are called Percentiles.



# Steps of getting Quartiles

## Steps to get Quartiles

**Step 1:** Arrange the data values from smallest to largest with n= no. of observations.

**Step 2:** Position of quartiles, $Q_i$: → $j = \frac{i \times n}{4}$; i= 1,2,3.

**Step 3:**

If **j** is an integer value

$$\frac{j^{th}observation + (j+1)^{th}observation}{2}$$

or

If **j** is not an integer value

Take the next integer value as the position

# Example of Quartile calculation

**Example:** The Exam marks of 6 students are: 50, 70, 64, 94, 78, 88. Find the $Q_1, Q_2$ and $Q_3$ and interpret the findings.

**Solution:**

1. Arranging the data to the smallest to largest,
   50, 64, 70, 78, 88, 94.

2. Position of $Q_i = \frac{i \times n}{4}$ Where, i= 1,2,3.
   n= no. of observations= 6

Now, Position of $Q_1 = \frac{1 \times 6}{4} = 1.5 \approx 2^{nd}$ observation=64. [Since not integer]

$\therefore Q_1 = 64.$

# Example of Quartile calculation

Position of $Q_2 = \frac{2 \times 6}{4} = 3$

$\therefore Q_2 = \frac{3^{rd}\,obsevation + 4^{th}\,observation}{2} = \frac{70+78}{2} = 74$ [Since integer]

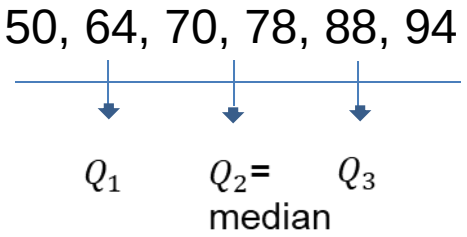
Now, Position of $Q_3 = \frac{3 \times 6}{4} = 4.5 \approx 5^{th}$ observation $= 88$. [Since not integer]

$\therefore Q_3 = 88.$

# Interpretation of quartiles

**Interpretation:**

$Q_1$ = 64 means, 25% data values are smaller than or equal to 64 and 75% data values are larger than or equal to 64.




$Q_2$ = 74 means, 50% data values are smaller than or equal to 74 and 50% data values are larger than or equal to 74.

$Q_3$ = 88 means, 75% data values are smaller than or equal to 88 and 25% data values are larger than or equal to 88.

# Steps of getting Deciles & Percentiles

**Steps to get Deciles and Percentiles (**similar as quartiles**):**

**Step 1:** Arrange the data values from smallest to largest with n= no. of observations.

**Step 2:**

Position of Deciles:

$j = \frac{i \times n}{10}$; i= 1,2,…,9

Position of percentiles:

$j = \frac{i \times n}{100}$; i= 1,2,…,99

**Step 3:**

If **j** is an integer value

$$\frac{j^{th}observation + (j+1)^{th}observation}{2}$$

or

If **j** is not an integer value

Take the next integer value as the position

# Calculation of Decile and percentile

**Example:**

The number of nuclear power plants in the top 15 nuclear power-producing countries in the world are listed. *(Source: International Atomic Energy Agency)*
7, 20, 16, 6, 58, 9, 20, 50, 23, 33, 8, 10, 15, 16, 104

- Find $2^{nd}$ Decile, $80^{th}$ Percentile. Interpret the results.

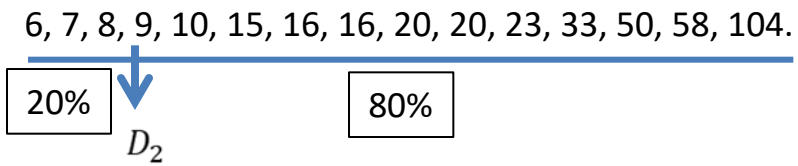
**Solution:**

Arranging the data to the smallest to largest,
6, 7, 8, 9, 10, 15, 16, 16, 20, 20, 23, 33, 50, 58, 104.

Position of $D_2 = \frac{2\times15}{10} = 3$

$\therefore D_2 = \frac{3^{rd} + 4^{th}}{2} = \frac{8+9}{2} = 8.5$

# Calculation of Decile and percentile




**Interpretation:**

$D_2$= 8.5 means, among 15 countries 20% countries have less than or equal to 9 nuclear power plants and 80% countries have more than 9 nuclear plants. **[since no. of nuclear plants is a discrete variable so 8.5≈ 9]**

# Calculation of Decile and percentile

Position of $P_{80} = \frac{80 \times 15}{100} = 12$

$\therefore P_{80} = \frac{12^{th} + 13^{th}}{2} = \frac{33+50}{2} = 41.5$

6, 7, 8, 9, 10, 15, 16, 16, 20, 20, 23, 33, 50, 58, 104.

80% $P_{80}$ 20%

**Interpretation:**

$P_{80} = 41.5$ means, among 15 countries 80% countries have less than or equal to 42 nuclear power plants and 20% countries have more than 42 nuclear plants. **[since no. of nuclear plants is a discrete variable so $41.5 \approx 42$]**

# Do yourself

For the previous math:

Prove that

- $Q_1 = P_{25}$;
- $Q_2 = P_{50}$=Median;
- $D_7 = P_{70}$;
- Interpret your findings.

# Exercises….

- Find the $Q_3$ , $D_7$, $P_{39}$ and $P_{85}$ of the following numbers.

12, 5, 22, 30, 7, 36, 14, 42, 15, 53, 25, 65

- Find $2^{nd}$ Quartile, $7^{th}$ Decile, $5^{th}$ Percentile and $68^{th}$ Percentile from the following data.

30,37,5,9,74,35,25,46,38,6,12,17,54,48,50,81,35.

- Age of 19 people are given below:

50,2,77,37,64,25,20,30,32,19,45,18,23,50,7,28,32,21,30.

Find the ages of 60% people, 15% people, 80% people and 50% people.

Thank you