

### 3.5 Measures of Spread

#### A Spread of Data

- ✓ measure of how far the numbers in a data set are away from the mean or the median

#### B Range

- ✓ difference between the greatest and the least values in a set of data

Example 1. Find the range for the following set of data.

12, 64, 11, 42, 9, 57, 13, 38, 12, 47, 43, 29, 36

greatest  
 least

$$\text{Range} = \text{Greatest} - \text{Least}$$

$$= 64 - 9$$

$$\therefore \text{Range} = 55$$

#### C Standard Deviation

- ✓ typical distance of a particular value from the mean for a set of data
- ✓ the greater the standard deviation, the greater the spread of data

$$SD = \sigma = \sqrt{\frac{(v_1 - \mu)^2 + (v_2 - \mu)^2 + \dots + (v_n - \mu)^2}{n}} \quad (2)$$

where  $\bar{x} = \text{mean}$  Mean  $\rightarrow \mu = \frac{v_1 + v_2 + v_3 + \dots + v_n}{n} \quad (1)$

$\bar{x}$  is the mean, and  $n$  is the number of values in the set of data.

Example 2. In a MDM3C class, the teacher was interested in the average height and the sample standard deviation of the heights of her students. The following data are the heights (in cm) for a sample of  $n = 10$  students.

150, 143, 165, 172, 168, 182, 175, 169, 160, 166

Value $x$	Sum of all values and Mean	Difference from the Mean $x - \mu$	The square of the difference from the Mean	Sum of all squares	Standard Deviation
150	$\text{Sum} = 150 + 143 + \dots$ $\text{Sum} = 1650$ $\mu = \frac{\text{Sum}}{n} = \frac{1650}{10}$	150 - 165 = -15	$(-15)^2 = 225$	$\text{Sum} = 225 + 484 + \dots$ $\text{Sum} = 1198$	$\sigma = \sqrt{\frac{\text{Sum}}{n}}$ $= \sqrt{\frac{1198}{10}}$ $\sigma = 10.9$
143		-22	484		
165		0	0		
172		7	49		
168		3	9		
182		17	289		
175		10	100		
169		4	16		
160		-5	25		
166		1	1		

$n = 10$   
 $\sigma = SD$   
 $\mu = 165$   
 11 SIGMA  
 $\therefore \sigma = 10.9$   
 Standard deviation

## D Technology

Technology (calculator or online applications) may be used to compute faster the range and the standard deviation of values in a set of data.

Example 3. Thirty farmers were asked how many farm workers they hire during a typical harvest season. Their responses were:

4, 5, 6, 5, 3, 2, 8, 0, 4, 6, 7, 8, 4, 5, 7, 9, 8, 6, 7, 5, 5, 4, 2, 1, 9, 3, 3, 4, 6, 4

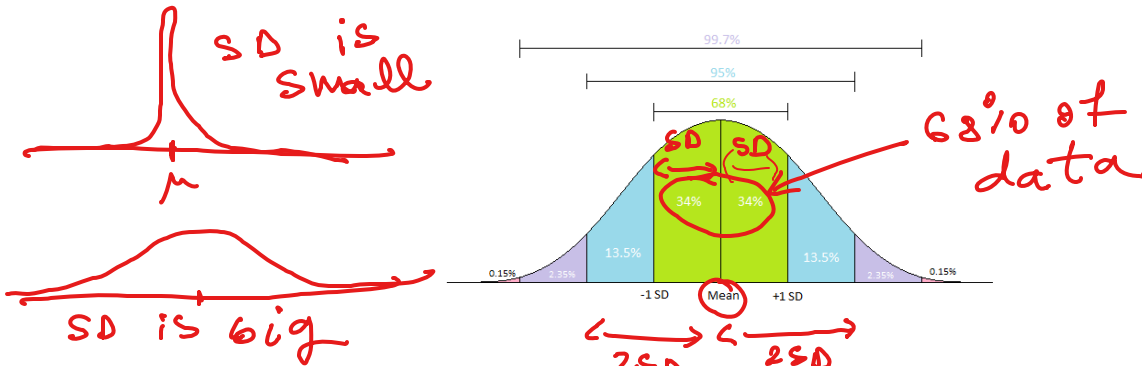
Calculate the range and the standard deviation for this set of data by using the online [Statistics Calculator](#).

$$R = 9$$

$$SD = 2.3$$

## E Meaning of the Standard Deviation

- ✓ Around 68% of values are within 2 standard deviations of the mean
- ✓ Around 95% of values are within 4 standard deviations of the mean
- ✓ Around 99.7% of values are within 6 standard deviations of the mean



Example 4. An audio magazine tested 60 different models of speakers and gave each one an overall rating based on sound quality, reliability, efficiency, and appearance. The raw scores for the speakers are listed in ascending order below.

35, 38, 41, 44, 45, 45, 47, 50, 51, 53, 53, 56, 57, 58, 58, 59, 60, 62, 62, 62, 62, 63, 63, 64, 64, 65, 65, 66, 67, 67, 67, 68, 68, 69, 69, 70, 72, 72, 73, 74, 75, 75, 76, 78, 79, 81, 82, 82, 83, 84, 86, 86, 87, 88, 90, 91, 92, 94, 96, 98

a) Calculate the mean and the standard deviation for this set of data by using the online [Statistics Calculator](#).

Range = 63    Mean = 68.12    Median = 67  
 Mode = 62    SD = 15.18

b) How many of the scores are placed in the interval  $(\mu - \sigma, \mu + \sigma)$ ? Is that 68%?

$$\mu - \sigma = 68.12 - 15.18 = 52.94$$

$$\mu + \sigma = 68.12 + 15.18 = 83.3$$

very close  
 $\frac{40}{60} = 66.7\%$   
 from theory    from our data

### Chapter 3 Assignment

Data below shows the heights in inches of 100 randomly selected adult men. Values are listed in ascending order.

65.6, 65.9, 66.2, 66.8, 67.0, 67.2, 67.3, 67.5, 67.6, 67.7, 67.8, 67.9, 68.0, 68.0, 68.1, 68.2, 68.3, 68.4, 68.6, 68.6, 68.6, 68.7, 68.7, 68.7, 68.8, 68.8, 68.9, 68.9, 69.0, 69.1, 69.1, 69.1, 69.2, 69.3, 69.3, 69.4, 69.4, 69.4, 69.5, 69.5, 69.5, 69.6, 69.6, 69.7, 69.7, 69.7, 69.8, 69.8, 69.8, 69.9, 70.0, 70.0, 70.0, 70.1, 70.1, 70.1, 70.2, 70.2, 70.3, 70.3, 70.4, 70.4, 70.4, 70.5, 70.5, 70.6, 70.6, 70.7, 70.7, 70.8, 70.8, 70.9, 70.9, 71.0, 71.0, 71.1, 71.1, 71.2, 71.2, 71.3, 71.3, 71.4, 71.5, 71.5, 71.6, 71.8, 71.8, 71.9, 71.9, 72.0, 72.2, 72.2, 72.3, 72.4, 72.5, 72.7, 72.8, 73.0, 73.7, 74.8

a) Calculate all statistics data by using the online [Statistics Calculator](#). [K 5]

Mean  $\mu$

Median

Mode

Range

Standard Deviation  $\sigma$

b) How many of the values are placed in the interval  $(\mu - \sigma, \mu + \sigma)$ ? Is that 68%? [T 3]

c) Create a histogram for this set of data. [A 5]

- Go to the online application [Social Science Statistics](#).
- Select the data, copy and paste in the area provided. Then click on the "Generate" button to create the histogram.
- Click on the histogram image and save it as an image on your computer.
- Upload the image in the Brightspace assignment.

Please enter your values above.

Generate