Definition 1. The **range** is the difference between the largest and smallest values of a data distribution.

Example: 13, 15, 12, 20, 9. (Find the range)

Step 1: Find max - min (order the data): Range = Max - Min = 20 - 9 = 11

Definition 2. The **sample standard deviation** is based on the difference between each data value and the mean of the data set.

Remark: The standard deviation gives an average of data spread around the mean. The larger the standard deviation, the more spread out the data are around the mean.

Q 1. How can we find the sample standard deviation?

(1st Formula) Definition Formula $S = \sqrt{\frac{\sum (x - \bar{x})^2}{n - 1}} = \sqrt{\frac{\sum x^2 - (\sum x)^2 / n}{n - 1}}$ (2nd Formula)

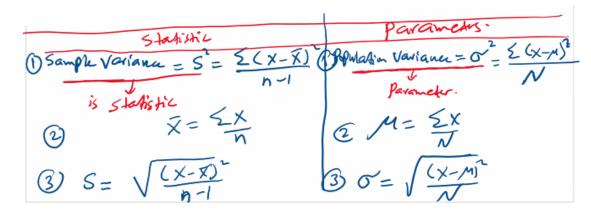
Definition 3. The variance tells us the square of standard deviation.

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

Remarks:

1.
$$\Sigma(\chi - \overline{\chi})^2 = \Sigma \chi^2 - (\underline{\Sigma} \chi)^2$$

- 2. For technical reason, we divide the sum by (n 1) [not by n]
- 3. Population vs Statistic:



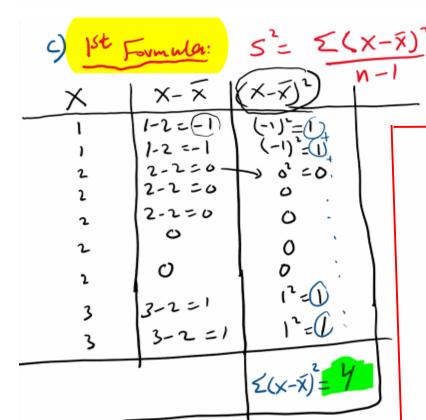
Example~1. The numbers of incorrect answers on a true-false competency test for a random sample of $\underline{9}$ students were recorded as follows

$$X = (1, 1, 2, 2, 2, 2, 2, 3, 3)$$

Find

a. Mean b. range c. variance d. standard deviation

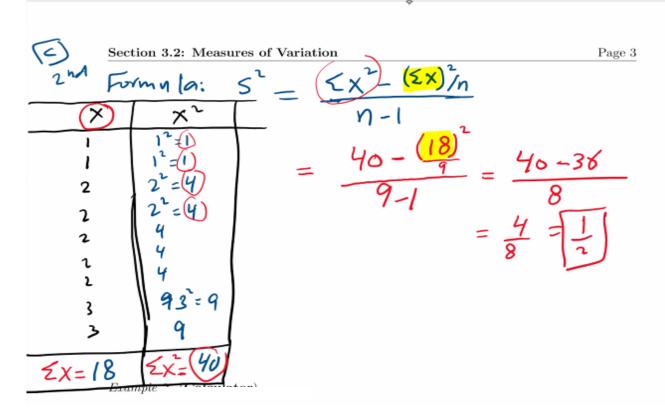
a)
$$Mean = \frac{2 \times 1}{n} = \frac{1+1+2+2+2+2+3+3}{9} = \frac{18}{9} = \boxed{2} = \boxed{2}$$



D) Standard Deviation

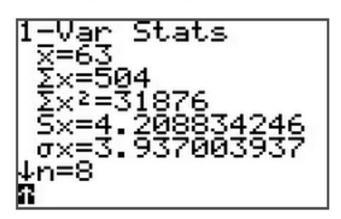
$$S = \sqrt{S^2}$$

$$= \sqrt{\frac{1}{2}} = \boxed{\frac{1}{\sqrt{2}}}$$



Example 2. (Calculator)

- · Press the [STAT] key and select 1:Edit
- . Enter in the data one at a time into L1
- · Press the [STAT] key, scroll to highlight CALC
- . Select 1: 1-Var Stats and press [ENTER]. The display will read: 1-Var Stats
- Press [2nd] followed by the [1] key to recall list 1. The display will read: 1-Var Stats L1
- · Press [ENTER] to display the calculated data
- · Scroll down to see all values



Example 3. Consider the data set 15, 5, 17, 5, 17.

1. Find the standard deviation; S.

Solution:

S=6.26 (**Do it!**)

2. Add 3 to each data value. Compute S. (POSSIBLE EXAM QUESTION)

New Data: 18, 8, 20, 8, 20

Standard Deviation = 6.26

Conclusion: Adding the same constant C to each data value results in the Standard Deviation remaining the same.

3. Multiply each data value by 3. Compute S.

Standard Deviation = 3 * 6.26 = 18.78