

**3.2 Measures of Variation**

Show work for full credit. Know how to do it by hand using the formula unless it says CALCULATOR!

**REMINDER:**

$\bar{x}$  = mean;  $\sigma$  = standard deviation;  $\sigma^2$  = variance; Med = median; Range = MaxX - MinX

The standard deviation is used to tell how far on average any data point is from the mean. The smaller the standard deviation, the closer the scores are on average to the mean. When the standard deviation is large, the scores are more widely spread out on average from the mean.

The **standard deviation** is calculated to find the **average distance from the mean**.

1. Calculate the standard deviation of the following test data by hand. Use the chart below to record the steps.

**TEST SCORES:** 22, 99, 102, 33, 57, 75, 100, 81, 62, 29

Mean: 66 n: 10

Test Score (x)	Difference from the mean (x - $\bar{x}$ )	(Difference from the mean) <sup>2</sup> (x - $\bar{x}$ ) <sup>2</sup>
22	22 - 66 = -44	(-44) <sup>2</sup> = 1936
99	99 - 66 = 33	(33) <sup>2</sup> = 1089
102	102 - 66 = 36	36 <sup>2</sup> = 1296
33	33 - 66 = -33	(-33) <sup>2</sup> = 1089
57	57 - 66 = -9	(-9) <sup>2</sup> = 81
75	75 - 66 = 9	(9) <sup>2</sup> = 81
100	100 - 66 = 34	34 <sup>2</sup> = 1156
81	81 - 66 = 15	15 <sup>2</sup> = 225
62	62 - 66 = -4	(-4) <sup>2</sup> = 16
29	29 - 66 = -37	(-37) <sup>2</sup> = 1369
Sum of (Difference from the mean) <sup>2</sup> : $\sum(x - \bar{x})^2$		8338

Sum of (Difference from the Mean)<sup>2</sup> divided by degrees of freedom (df = n - 1): 926.444  
 This is variance.

$$\frac{8338}{9}$$

Final Step:

**Standard deviation** = square root of what you just calculated (variance).

$$\text{Standard deviation} = \sqrt{\frac{\sum(x - \bar{x})^2}{n-1}} = \underline{30.438}$$

2. The data set below gives the prices (in dollars) of cordless phones at an electronics store.

35, 50, 60, 60, 75, 65, 80

$$\bar{x} = 60.714 \quad n = 7$$

Find the mean and standard deviation.

$$\begin{aligned} & (-25.714)^2 + (-10.714)^2 + (-.714)^2 + (-.714)^2 + (14.286)^2 + (4.286)^2 + (19.286)^2 \\ & (661.210) + (114.790) + (.510) + (.510) + (204.090) + (18.370) + (371.950) \\ & = \frac{1371.43}{6} = 228.572 \quad \boxed{S_x = 15.119} \end{aligned}$$

3 – 5: Answer the following questions. Know how to do them by hand, but at this point you are fine to use your calculator to solve for each of the parts.

3. The data set below gives the numbers of home runs for the 10 batters who hit the most home runs during the 2005 Major League Baseball regular season.  $n=10$

51, 48, 47, 46, 45, 43, 41, 40, 40, 39

a. Mean  $\bar{x} = 44$

b. Median  $\tilde{x} = 44$

c. Mode = 40

d. Range  $51 - 39 = \boxed{12}$

4. The data set below gives the waiting times (in minutes) of several people at a department of motor vehicles service center.  $n=15$

11, 7, 14, 2, 8, 13, 3, 6, 10, 3, 8, 4, 8, 4, 7

a. Mean  $\bar{x} = 7.2$

b. Median  $\tilde{x} = 7$

c. Mode = 8

d. Range =  $14 - 2 = \boxed{12}$

e. Standard Deviation  $s_x = 3.668$

f. Variance =  $s_x^2 = (3.668)^2 = \boxed{13.454}$

5. The data set below gives the calories in a 1-ounce serving of several breakfast cereals.  $n=9$

135, 115, 120, 110, 110, 100, 105, 110, 125

a. Mean  $\bar{x} = 114.444$

b. Median  $\tilde{x} = 110$

c. Mode = 110

d. Range =  $135 - 100 = \boxed{35}$

e. Standard Deviation =  $s_x = 10.737$

f. Variance =  $s_x^2 = (10.737)^2 = \boxed{115.283}$