Notes 12.3
Measures of Dispersion

Measures of dispersion are used to describe the spread of data values in a data set. Two of the most common measures of dispersion are **range** and **standard deviation**. To find the range, subtract the smallest data value from the largest data value.

1-3 Refer to the bar graph (Figure 1) of the number of trips four people made to Starbucks last month.

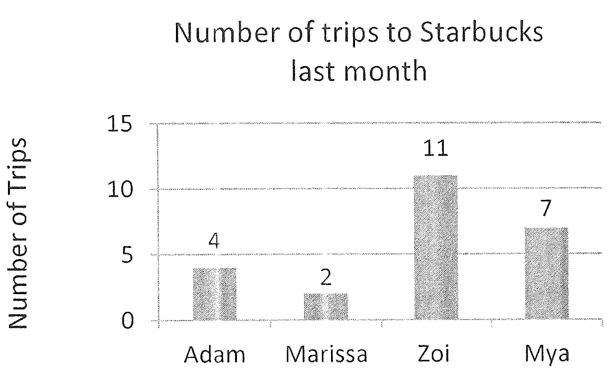

Figure 1

1) Find the range for the number of trips the four people made to Starbucks last month.

$11 - 2 = 9$ trips

Another measure of dispersion is **standard deviation**. Standard deviation is found by determining how much each data value differs from the mean. The more spread out the data values are from the mean, the bigger the standard deviation will be. The symbol for the standard deviation for a sample is "s".

2) Find the mean and the deviations from the mean for the data values in Figure 1.

$\bar{X}$ = mean = $\frac{4+2+11+7}{4} = \frac{24}{4} = 6$

deviation: data item − mean

$4 - 6 = -2$
$2 - 6 = -4$
$11 - 6 = 5$
$7 - 6 = 1$

COMPUTING THE STANDARD DEVIATION FOR A DATA SET

1. Find the mean of the data items.
2. Find the deviation of each data item from the mean:

   data item − mean.
3. Square each deviation:

   (data item − mean)^2.
4. Sum the squared deviations:

   Σ(data item − mean)^2.
5. Divide the sum in step 4 by $n - 1$, where n represents the number of data items:

   $$\frac{\Sigma(\text{data item} - \text{mean})^2}{n-1}.$$
6. Take the square root of the quotient in step 5. This value is the standard deviation for the data set.

   $$\text{Standard deviation} = \sqrt{\frac{\Sigma(\text{data item} - \text{mean})^2}{n-1}}$$

Σ deviation from mean ALWAYS $\emptyset$

so $\Sigma(\;)^2$

* $s = \sqrt{\dfrac{\Sigma(x-\bar{x})^2}{n-1}}$ Kind of average of deviations from mean

3) Find the standard deviation for the data values in Figure 1.

x	$x - \bar{x}$	$(x-\bar{x})^2$
4	$4-6 = -2$	$(-2)^2 = 4$
2	$2-6 = -4$	$(-4)^2 = 16$
11	$11-6 = 5$	$5^2 = 25$
7	$7-6 = 1$	$1^2 = 1$

$s =$

$\Sigma(x-x^2) = 46$

$$\frac{4+16+25+1}{4-1} = \frac{46}{3} \qquad s = \sqrt{\frac{4+16+25+1}{4-1}} = \sqrt{\frac{46}{3}} = \boxed{3.92} = s$$

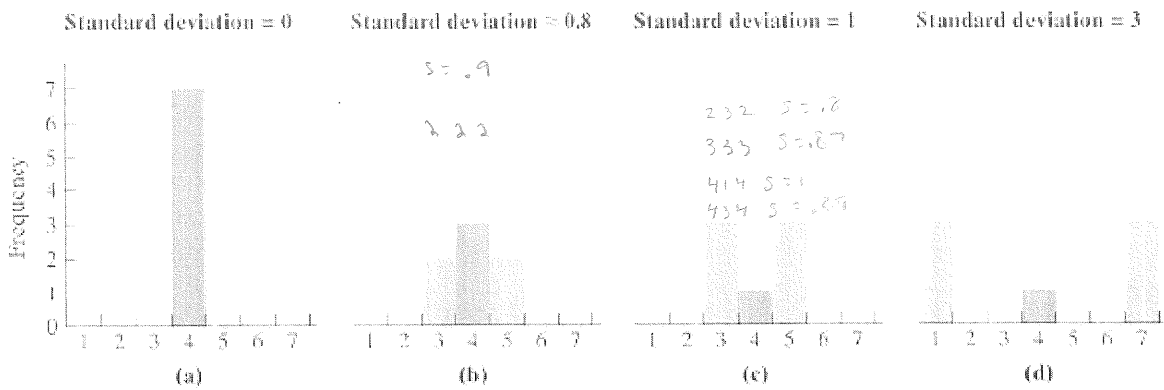

FIGURE 12.8 The standard deviation gets larger with increased dispersion among data items. In each case, the mean is 4.

4) Calculate the standard deviation for the following set of data: 4, 9, 11, 12, 17, 5, 8, 10, 14

$\frac{90}{9} = 10$

$\bar{x} = 10$

X	$X - \bar{X}$	$(X - \bar{X})^2$
4	4 − 10 = −6	36
9	9 − 10 = −1	1
11	11 − 10 = 1	1
12	12 − 10 = 2	4
17	17 − 10 = 7	49
5	5 − 10 = −5	25
8	8 − 10 = −2	4
10	10 − 10 = 0	0
14	14 − 10 = 4	16

$\Sigma (x - \bar{x})^2 = 136$

$\frac{136}{n-1} = 17$ $\quad \sqrt{17} = \boxed{4.12 = \text{std dev} = s}$

[Stats / Calc 1-Var stats / Sx] = std dev

Using the Stat Button to find Standard Deviation

5) Find the mean and the standard deviation for the following set of data using the stat button on your graphing calculator: 778, 472, 147, 106, 82.

Stat | Edit   enter data values

Stat | Calc | 1-Var stats L_1 $\bar{x} = 317$

$s = 302.16$

6) The test scores of two students are given below. Find the mean and the standard deviation for the test scores of each student.

Student A: 73, 75, 77, 79, 81, 83 $\bar{x} = 78$ $s = 3.74$

Student B: 40, 44, 92, 94, 98, 100 $\bar{x} = 78$ $s = 28.06$

7) Imagine customers waiting in line for tellers at two different banks. Customers at Big Bank can enter any one of three different lines leading to three different tellers. Best Bank also has three tellers, but all customers wait in a single line and are called to the next available teller. The following values are waiting times, in minutes, for eleven customers at each bank. The times are arranged in ascending order. Calculate the mean and the standard deviation for the waiting times at Big Bank and at Best Bank. What conclusion can you make about the waiting times at the banks? How are they similar/ different?

Big Bank (three lines): 4.1 5.2 5.6 6.2 6.7 7.2 7.7 7.7 8.5 9.3 11.0

$\bar{x} = 7.2$ $s = 1.96$

Best Bank (one line): 6.6 6.7 6.7 6.9 7.1 7.2 7.3 7.4 7.7 7.8 7.8

$\bar{x} = 7.2$ $s = .44$

Same mean, Big Bank has larger std deviation

8) Shown below are the means and standard deviations of the yearly returns on two investments from 1926 through 2004.

Investment	Mean Yearly Return	Standard Deviation
Small-Company Stocks	17.5%	33.3%
Large-Company Stocks	12.4%	20.4%

a. Use the means to determine which investment provided the greater yearly return.

Small Co had greater yearly return

b. Use the standard deviations to determine which investment had the greater risk. Explain your answer.

Small Co had greater risk since the return each year varied more