NOTES--Measures of Dispersion

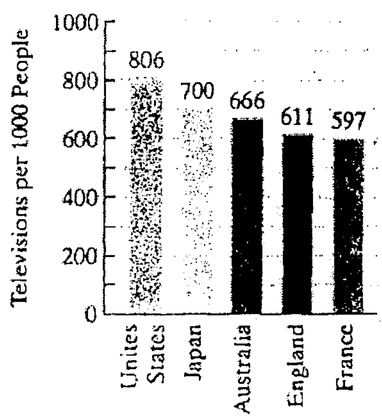
measures of dispersion-- describe the spread of the data items

the 2 types of dispersion we will study:

1. range
2. standard deviation

> **THE RANGE**
>
> The **range**, the difference between the highest and lowest data values in a data set, indicates the total spread of the data.
>
> Range = highest data value − lowest data value

Example 1 The average person living in the United States watches about 1551 hours of television per year. That's equal to nearly 65 straight days, or 18% of one year. Figure 12.11 shows the five countries with the most televisions per 1000 people. Find the range of televisions per 1000 people for the five countries with the most televisions per capita.



806 − 597 = 209

Example 2 **a.** Find the range for this set of data: 16, 22, 28, 28, 34 34 − 16 = 18

b. Find the range for this set of data: 312, 783, 219, 312, 426, 219 783 − 219 = 564

(sample)

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:

$$\text{data item} - \text{mean}.$$

3. Square each deviation:

$$(\text{data item} - \text{mean})^2.$$

4. Sum the squared deviations:

$$\Sigma(\text{data item} - \text{mean})^2.$$

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.

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

Example 3 Find the standard deviation for the television data in example #1.

data item	deviation	$(\text{dev.})^2$
806	130	16900
700	24	576
666	-10	100
611	-65	4225
597	-79	6241
		28042

$\text{mean} = \frac{3380}{5} = 676$

$\frac{28042}{4} = 7010.5$

$SD = \sqrt{7010.5} = 83.73$

Example 4 Find the standard deviation of the data items in each of the samples shown below.

Sample A

17, 18, 19, 20, 21, 22, 23

$\text{mean} = \frac{140}{7} = 20$

data	$(\text{dev})^2$
17	9
18	4
19	1
20	0
21	1
22	4
23	9
	28

$SD = \sqrt{\frac{28}{6}} = 2.16$

Sample B

5, 10, 15, 20, 25, 30, 35

$\text{mean} = \frac{140}{7} = 20$

data	$(\text{dev})^2$
5	225
10	100
15	25
20	0
25	25
30	100
35	225
	700

$SD = \sqrt{\frac{700}{6}} = 10.80$

Example 5 Two fifth grade classes have nearly identical mean scores on an aptitude test, but one class has a standard deviation three times that of the other. All other factors being equal, which class is easier to teach, and why?

lower St. dev — kids would be more on the same level

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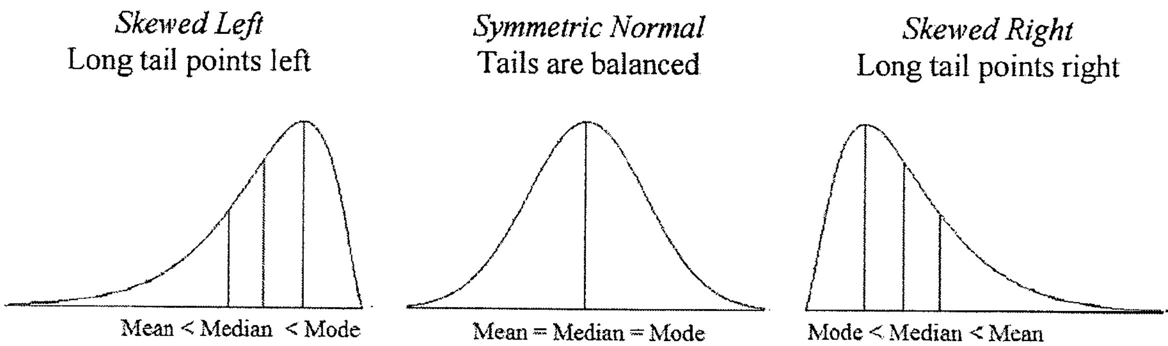
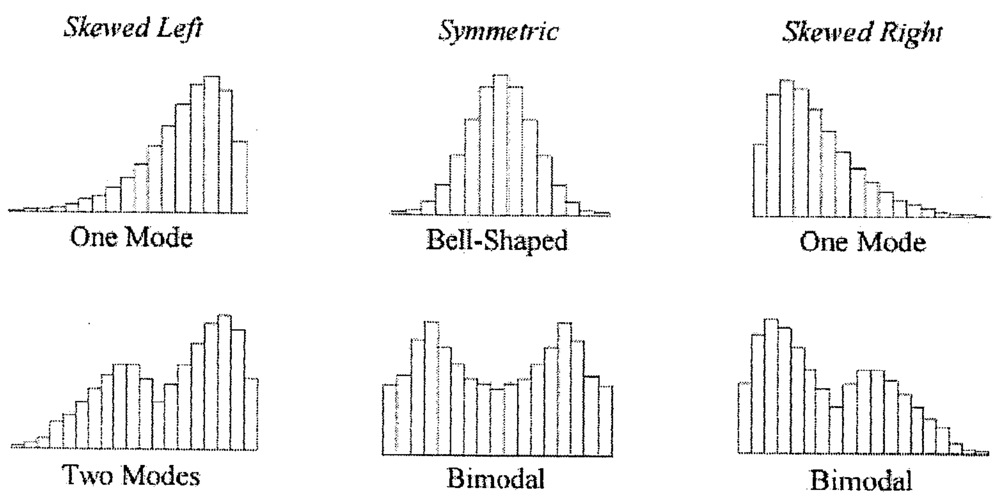
A "measure of dispersion" tells us about the variation of the data set. **Skewness** tells us about the *direction of variation* of the data set.

Definition: **Skewness** is a measure of symmetry, or more precisely, the lack of symmetry.

- A distribution, or data set, is <u>symmetric</u> if it looks the same to the left and right of the center point.
- A distribution that is <u>skewed left</u> has fewer data values on the left side than the right side.
- A distribution that is <u>skewed right</u> has fewer data values on the right side than the left side.



Sketches showing general position of mean, median, and mode in a population

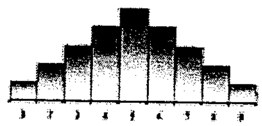


As a quick way to remember skewness:

- *longer tail on the left* means *skewed to the left* means *mean on the left of median* (smaller)
- *longer tail on the right* means *skewed to the right* means *mean on the right of median* (larger)
- *tails equally long* means *normal* means *mean about equal to median*

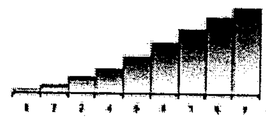
Example Describe the shape of the data.

A.



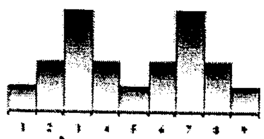
symmetric

B.



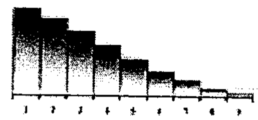
skewed left

C.



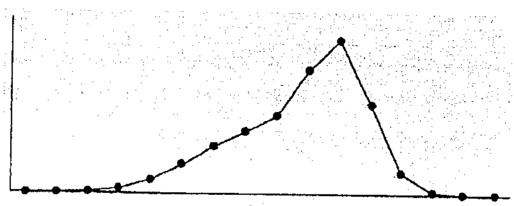
bimodal
symmetric

D.



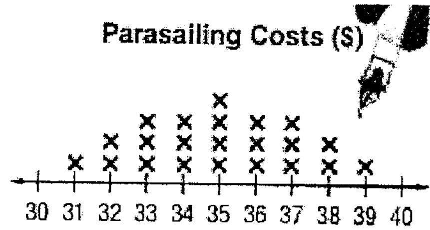
skewed right

E.



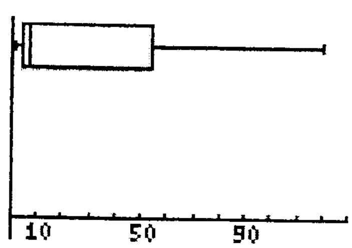
skewed left

F.



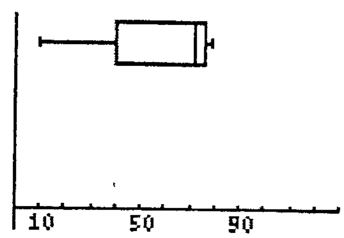
symmetric

G.



skewed right

H.



skewed left

I.

1	355555556666667777788889999
2	8
3	1556666899
4	0125
5	01
6	133466
7	014567
8	169
9	7
10	139
11	13678
12	39
13	24457
14	39
15	16
16	0
17	
18	2
19	3

skewed right

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