KEY

Section 17.3: Variability
Essential Question: How do you calculate standard deviation and Z-scores?

Definitions

Statistic: is a number that describes some characteristic of a set of data

Mean, Median, Mode: describe the Center of a set of data

Range and **Interquartile Range:** describe the Spread of the data about the center or called Measure of Dispersion (how much data varies)

Example 1:
The following 3 classes have the given test scores.

Class 1	Class 2	Class 3
50, 50, 50, 50, 50	40, 50, 50, 50, 60	10, 40, 50, 60, 90
Mean = 50	Mean = 50	Mean = 50
Range = $50-50=\boxed{0}$	Range = $60-40=\boxed{20}$	Range = $90-10=\boxed{80}$

OTHER MEASURES OF DISPERSION: Variance and Standard Deviation

Variance: Written as s^2 or σ^2 (sigma squared)

Data: $x_1, x_2, x_3, x_4, \ldots, x_n$ (n = # of items)

Mean = $\bar{x} = \frac{\text{sum of data}}{n}$

$$\boxed{\sigma^2 = s^2 = \frac{(x_1-\bar{x})^2+(x_2-\bar{x})^2+(x_3-\bar{x})^2+\ldots}{n}}$$

Standard Deviation: Written as s or σ

*It is how much items are dispersed around the mean – NOT an average!

$$\boxed{\sigma = \sqrt{\text{variance}}} = \sqrt{\sigma^2}$$

Example 2:
Five pairs of shoes cost $10, $20, $30, $40 and $50.

$$\text{Mean} = \bar{x} = \frac{10+20+30+40+50}{5} = \frac{150}{5} = 30$$ → average shoe pair is \$30

$$\text{Variance} = \sigma^2 = \frac{(10-30)^2+(20-30)^2+(30-30)^2+(40-30)^2+(50-30)^2}{5} = \frac{1000}{5} = 200$$

$$\text{Standard Deviation} = \sqrt{\text{variance}} = \sqrt{200} \approx \boxed{\$14.14}$$

*not an average
* a measure of dispersion

$30-14.14 = \$15.86$
$30+14.14 = \$44.14$
most shoes cost between

Example 3:
Find the standard deviation for 1, 7, 9, 15

$\bar{X} = \frac{1+7+9+15}{4} = \frac{32}{4} = 8$

Variance $= \sigma^2$

$= \frac{(1-8)^2+(7-8)^2+(9-8)^2+(15-8)^2}{4} = \frac{100}{4} = 25$

St. dev $= \sigma = \sqrt{25} = \boxed{5}$

Example 4:
Find the mean and standard deviation from the table of data.

x_i = item of data	4	6	10
f_i = frequency	2 +	5 +	3 = 10

\# of distinct data items = 3

\# of total data items = 10

$\bar{X} = \frac{2(4)+5(6)+3(10)}{10} = \frac{68}{10} = 6.8$

$\sigma^2 = \frac{2(4-6.8)^2+5(6-6.8)^2+3(10-6.8)^2}{10} = \frac{49.6}{10} = 4.96$

St. dev $= \sqrt{\text{var}}$

$\sigma = \sqrt{4.96}$

$\boxed{\sigma = 2.22}$

Standard Value (z) of a piece of data

Standard Value = $\frac{\text{data item} - \text{mean}}{\text{Standard deviation}}$ OR $z = \frac{X - \bar{X}}{\sigma}$

Z give you the number of standard deviations between an item of the data and the mean
(Also called z-score or relative score)

Example 5:
Use data from example 2 to find the standard value if you had a score of…

1, 7, 9, 15 $\bar{X} = 8$ $\sigma = 5$

Score of 1	Score of 7	Score of 9	Score of 15
$z = \frac{1-8}{5} = \boxed{-1.4}$	$z = \frac{7-8}{5} = \boxed{-.2}$	$z = \frac{9-8}{5} = \boxed{.2}$	$z = \frac{15-8}{5} = \boxed{1.4}$

Section 17.3 Summary:

Standard Deviation measures dispersion (spread)

① Find mean $= \bar{X} = \frac{\text{sum of data}}{\text{\# of items}}$

② Calculate variance $= s^2 = \sigma^2 = \frac{(\text{data}_1-\bar{X})^2+(\text{data}_2-\bar{X})^2+(\text{data}_3-\bar{X})^2+\ldots}{n}$ n ← # of items

③ standard dev. $= \sigma$ or $s = \sqrt{\text{variance}}$