Measures of Variability

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Measures of Variability

spread or dispersion of scores.

variability is to obtain a measure of how spread out the scores are in a distribution

Central tendency describes the central point of the distribution, and variability describes how the scores are scattered around that central point

Indicates how spread the values of a given variable are from the **Average (Mean).**
Dispersion = variety, diversity, amount of variation between scores

Measures of variability tell us:

scores differ from each other or **how spread out** the scores are.

How **accurately** the **measure of central tendency describes** the distribution.

shape of the distribution.
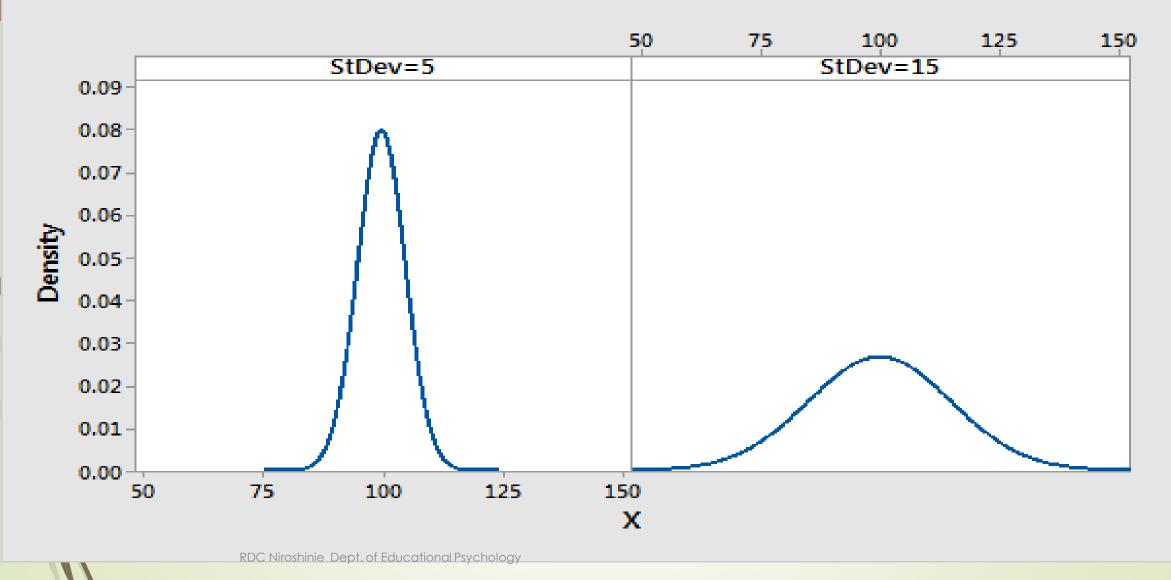
CONSIDER TWO GROUPS OF SCORES

GROUP 1 = 9, 5, 1;   GROUP 2 = 5, 6, 4

CALCULATE MEAN AND MEDIAN

Normal Distributions with the Same Mean but Different Variability

Normal, Mean=100

Measuring Variability

the range
the interquartile range(IQR)
the standard deviation

Range:

The range is a measure of the distance between highest and lowest.

12	14	15	17	19	20		9	
12	14	15	17	19	20	65	54	9
1	14	15	17	19	20		20	
23	71	75	82	77	86	85	64	16

The Interquartile Range

"Quartile basically means "quarter" or "fourth." Finding the quartiles of a distribution is as simple as breaking it up into fourths. Each fourth contains 25 percent of the total number of observations.

Quartiles divide a rank-ordered data set into four equal parts. The values that divide each part are called the first, second, and third quartiles; and they are denoted by Q1, Q2, and Q3, respectively.

Q1 is the "middle" value in the first half of the rank-ordered data set.
Q2 is the median value of the data set
Q3 is the "middle" value of the second half of the rank-ordered data set

The Interquartile Range

- The **interquartile range** is the distance covered by the middle 50% of the distribution (the difference between Q1 and Q3).

- The *interquartile range* is the value of the case that stands at the *75th percentile* of the distribution minus the value of the case that stands at the 25th percentile.

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- IQR = Q3-Q1 $(P_{75} - P_{25})$

18   25   34   45   58   59   62   66   72

18   **25**   **34**   45   **58**   59   **62**   **66**   72

$Q1/P_{25} = (25+34)/2$ $Q3/P_{75} = (62+66)/2$

     $=29.5$ $= 64$

$IQR= 64-29.5$

     $= $ **34.5**

| 18 | 25 | 34 | 45 | 58 | 60 | 62 | 66 | 72 | 88 |

| 18 | **25** | 34 | 45 | 58 59 60 | | **62** | 66 | 72 | 88 |

Md= (58+60)/2

= **59**

Q1/P_{25} = 34   Q3/P_{75} = 66

=34   = 66

IQR= 66-34

= **32**

What is a standard deviation?

Standard Deviation:

It is the typical **(standard)** difference **(deviation)** of an observation from the mean.

Standard deviation measures the standard distance between a score and the mean.

IQR 12 Mean 41   IQR   13   Mean   68

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Standard deviation measures the standard distance between a score and the mean.

$$s = \sqrt{\sum \frac{(X - \bar{X})^2}{n}}$$

The standard deviation is calculated by taking **the square root of the variance.**

Mean 52	?	?	?	52	?	?
SD/S 5	37	42	47	52	57	62
SD/S 2	46	48	50	52	54	56
SD 10	22	32	42	52	62	72

Variance: Weeks on Unemployment:

Step 1: Calculate the Mean	Step 2: Calculate Deviation	Step 3: Calculate Sum of square Dev	Step 4: Calculate the Mean of squared dev.	Step 5: Calculate the Square root of the Var.
X (weeks)	Deviation: $(X - \bar{X})$	$(X - \bar{X})^2$ (raw score from the mean, squared)	Variance: $s^2 = \dfrac{\sum(X - \bar{X})^2}{N}$	Standard Deviation: $s = \sqrt{\sum \dfrac{(X - \bar{X})^2}{n}}$ (square root of the variance)
9 8 6 4 2 1	9-5= 4 8-5=3 6-5=1 4-5=-1 2-5=-3 1-5=-4	$4^2 = 16$ $3^2 = 9$ $1^2 = 1$ $-1^2 = 1$ $-3^2 = 9$ $-4^2 = 16$	$\dfrac{52}{6} = 8.67$ (weeks squared)	$\sqrt{8.67}$
$\Sigma X = 30$ $\bar{X} = \dfrac{30}{6} = 5$		$\sum(X - \bar{X})^2 = 52$		s = 2.94

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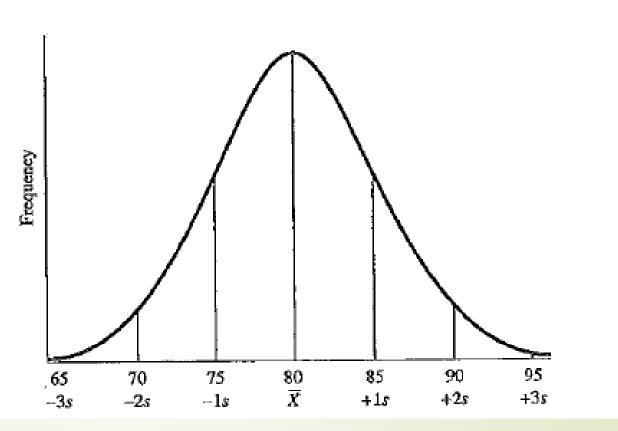
Standard Deviation

Standard Deviation: **Baseline of a Frequency Polygon.**

The baseline of a frequency polygon can be measured in units of standard deviation.

Example:

$\overline{X}$ = 80

s = 5

Then, the raw score 85 lies one Standard Deviation above the mean (+1s).

Standard Deviation
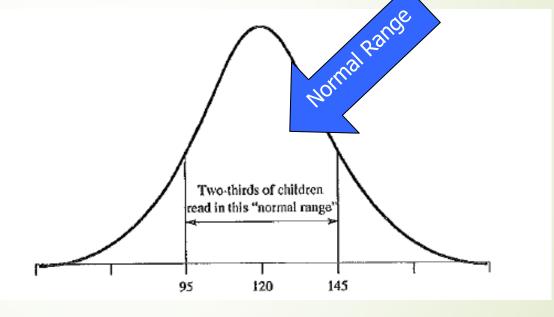
Standard Deviation: The Normal Range

Unless highly skewed, approximately **two-thirds of scores** within a distribution will fall within the **one standard deviation above and below the mean**

Example: Reading Levels
Words per minute.

$$\overline{X} = 120$$
$$s = 25$$

Normal Range

Two-thirds of children read in this "normal range"

95   120   145

	Group-A	Group-B	Group-C
Md	55	34	62
$\overline{X}$	48	48	65
SD/S	4	8	4