# January 9, 2012

| Monday | Tuesday | Wednesday | Thursday | Friday |
|---|---|---|---|---|
| 9<br>S.D. | 10 Substitute<br>Review | 11 - Dance Assembly<br>Correct all of it | 12<br>Test | 13 - Drop Dead Day<br>M.U. |
| 16 | 17 | 18 - Minimal Day | 19 | 20 |

# 1/9 - Standard Deviation

**Standard deviation** is a widely used measure of variability or diversity used in statistics and probability theory. It shows how much variation or "dispersion" exists from the average (mean, or expected value). A low standard deviation indicates that the data points tend to be very close to the mean, whereas high standard deviation indicates that the data points are spread out over a large range of values.

$$\sigma = \sqrt{\frac{1}{N}\left[(x_1-\mu)^2+(x_2-\mu)^2+\cdots+(x_N-\mu)^2\right]}, \quad \text{where} \quad \mu = \frac{1}{N}(x_1+\cdots+x_N)$$

$$\sigma = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(x_i-\mu)^2}, \quad \text{where} \quad \mu = \frac{1}{N}\sum_{i=1}^{N}x_i$$

$$s_N = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(x_i-\overline{x})^2}$$

So, basically, standard deviation tells how close together data is in relation to the mean.

Both of these groups of number have the same mean of 10.

| Spread out more | Closer together |
|---|---|
| 1 | 7 |
| 3 | 8 |
| 5 | 9 |
| 9 | 9 |
| 11 | 11 |
| 14 | 11 |
| 17 | 12 |
| 20 | 13 |

S.D. will be higher

S.D. will be lower

## Simplified Method 1:

$$S = \sqrt{\frac{(x_1 - \bar{x})^2 + (x_2 - \bar{x})^2 + \cdots + (x_n - \bar{x})^2}{n}}$$

$\bar{x}$ *is the mean of* $x_1, x_2, \ldots$ *and* $x_n$

$\bar{x} = 10$

| | | $x$ | $x-10$ | $(x-10)^2$ |
|---|---|---|---|---|
| 1 | $x_1$ | 1 | -9 | 81 |
| 3 | $x_2$ | 3 | -7 | 49 |
| 5 | $x_3$ | 5 | -5 | 25 |
| 9 | ⋮ | 9 | -1 | 1 |
| 11 | ⋮ | 11 | 1 | 1 |
| 14 | ⋮ | 14 | 4 | 16 |
| 17 | ⋮ | 17 | 7 | 49 |
| 20 | $x_n = x_8$ | 20 | 10 | 100 |

$$S = \sqrt{\frac{81+49+25+1+1+16+49+100}{8}}$$

$$= \sqrt{\frac{322}{8}}$$

$$= \sqrt{40.25} \doteq 6.3$$

## Simplified Method 2:

$$S = \sqrt{\frac{x_1^{\,2} + x_2^{\,2} + \cdots + x_n^{\,2}}{n} - \bar{x}^2}$$

$\bar{x}$ *is the mean of* $x_1, x_2, \ldots$ *and* $x_n$

$\bar{x} = 10$

| $x$ | $x^2$ |
|---|---|
| 7 | 49 |
| 8 | 64 |
| 9 | 81 |
| 9 | 81 |
| 11 | 121 |
| 11 | 121 |
| 12 | 144 |
| 13 | 169 |

$$S = \sqrt{\frac{49+64+81+81+121+121+144+169}{8} - 10^2}$$

$$S = \sqrt{\frac{830}{8} - 100}$$

$$S = \sqrt{103.75 - 100}$$

$$S = \sqrt{3.75} \doteq 1.9$$

# Homework

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Due: