

Standard Deviation of a Discrete Random Variable:

Sample Question and Data:

Talia wants to play a basketball game at a carnival. The game costs the player \$5 to play, and the player gets to take two long-distance shots. If they miss both shots, they get nothing. If they make one shot, they get their \$5 back. If they make both shots, they get \$10 back. Talia has a 40% percent chance of making this type of shot.

Probability distribution of X = the amount of money Talia gains from playing the game and the given mean:

Money Gained	X	-\$5	\$0	\$5
Probability	P(X)	0.36	0.48	0.16
Mean	μ_X	-\$1		

Definition:

In the case of a discrete random variable **X**, **standard deviation** (σ_X) tells us how much each outcome typically varies from the mean.

To find the standard deviation:

- Square the difference between each outcome and the mean.
- Multiply those squared values by their respective probabilities.
- Add those products to get the variance.
- Take the square root of the variance to get the standard deviation.

Formula for Variance:

$$Var(X) = \sigma_X^2 = (x_1 - \mu_x)^2 p_1 + (x_2 - \mu_x)^2 p_2 + \dots + (x_n - \mu_x)^2 p_n = \sum (x_i - \mu_x)^2 p_i \quad (1)$$

Calculations:

- Variance (given $\mu_X = -\$1$):

$$\begin{aligned} Var(X) = \sigma_X^2 &= \sum (x_i - \mu_x)^2 p_i = \\ &= (-5 - (-1))^2(0.36) + (0 - (-1))^2(0.48) + (5 - (-1))^2(0.16) \\ &= \end{aligned} \qquad \qquad \qquad 12$$

- Standard Deviation:

$$\sigma_X = \sqrt{Var(X)} = \sqrt{12} \approx \boxed{3.464}$$