

Example: Suppose we hold 1 of 1000 raffle tickets.

| | | |
|-----------------|---|------------|
| One 1st prize | = | \$250 |
| Two 2nd prizes | = | \$100 each |
| Four 3rd prizes | = | \$50 each |

On the average, how much is our ticket worth?

Example: A potential customer for a \$200,000 fire insurance policy has a home in an area where, in a given year, the probability of a total loss is 0.0003, and the probability of a 50% loss is 0.001. What premium must be charged for the company to break even?

If we have a random variable X and the associated pdf $f(x)$, then

The mean of the random variable X is $E[X]$.

Also called the mean of the distribution

Or the mean of the population

Denoted μ

The variance of rv X is $E[(X-\mu)^2]$.

Also called the variance of the distribution

Or the variance of the population

Expected/average squared deviation from the mean

Equivalent to $E(X^2) - \mu^2$

Denoted σ^2 or $\text{Var}(X)$

The standard deviation of rv X is $\sqrt{\text{Var}(X)}$

Denoted σ , or $\text{SD}(X)$.

Example: Toss a fair coin, and let rv X count the number of Heads on the toss (so 0 or 1).

| x | $P(x)$ |
|-----|--------|
| 0 | 1/2 |
| 1 | 1/2 |

What is the mean & SD of this distribution?

Example: Toss an unfair coin, and let rv X count the number of Heads on the toss (so 0 or 1).

Suppose

| x | $P(x)$ |
|-----|--------|
| 0 | 0.2 |
| 1 | 0.8 |

What is the mean & SD of this distribution?

Example: Toss three fair coins, and we let rv X count the number of Heads on the three coins.

| x | $P(x)$ |
|-----|--------|
| 0 | $1/8$ |
| 1 | $3/8$ |
| 2 | $3/8$ |
| 3 | $1/8$ |

What is the mean & SD of this distribution?



| <u>Prize</u> | <u>Probability</u> |
|--------------|--------------------|
| 5000 | 0.000 003 |
| 100 | 0.000 347 |
| 50 | 0.002 569 |
| 15 | 0.003 333 |
| 10 | 0.010 000 |
| 5 | 0.010 000 |
| 4 | 0.020 000 |
| 2 | 0.076 667 |
| 1 | 0.086 655 |



| <u>Prize</u> | <u>Probability</u> |
|--------------|--------------------|
| 4000 | 0.000 004 |
| 100 | 0.001 042 |
| 40 | 0.001 389 |
| 20 | 0.003 333 |
| 10 | 0.006 667 |
| 6 | 0.003 333 |
| 5 | 0.010 000 |
| 4 | 0.020 000 |
| 2 | 0.076 667 |
| 1 | 0.086 655 |

World Series of Baseball

| <u>Games</u> | <u>Probability</u> |
|--------------|--------------------|
| 4 | 0.1250 |
| 5 | 0.2500 |
| 6 | 0.3125 |
| 7 | 0.3125 |

Suppose we run a bakery. We bake cakes each day, and we know from history that the number of cakes we could sell each day follows this pdf:

$$f(x) = 1/6 \quad \text{for } x=1,2,3,4,5,6$$

We make a \$5 profit on each cake we sell, but we suffer a \$3 loss for each cake we bake that we don't sell. If we choose to bake just 1 cake, what is our expected value?

What about 2, 3, 4, 5 or 6 cakes?



Five white balls selected from 1 to 69
 One red ball selected from 1 to 26.

=

Total possible combinations: 292,201,338

POWERBALL PRIZES AND ODDS

| Match | Prize | Odds (based on \$2 play) |
|---------------------------------|-------------|--------------------------|
| ● ● ● ● ● + ● | Grand prize | 1 in 292,201,338 |
| ● ● ● ● ● | \$1,000,000 | 1 in 11,688,054 |
| ● ● ● ● ● + ● | \$50,000 | 1 in 913,129 |
| ● ● ● ● ● | \$100 | 1 in 36,525 |
| ● ● ● ● + ● | \$100 | 1 in 14,494 |
| ● ● ● ● | \$7 | 1 in 580 |
| ● ● ● + ● | \$7 | 1 in 701 |
| ● ● + ● | \$4 | 1 in 92 |
| ● + ● | \$4 | 1 in 38 |
| ● | \$4 | 1 in 38 |
| Overall odds of winning a prize | | 1 in 25 |

Source: powerball.com