Sample space (S) — All possible outcomes in an experiment.

ex. Tossing a coin. $S = \{H, T\}$.

ex. Roll a die. $S = \{1, 2, 3, 4, 5, 6\}$.

ex. Toss a coin 3 times.

$S = \{HHH, HTH, HHT, THH, THT, TTH, HTT, TTT\}$.

$2 \times 2 \times 2 = 8$

Event - A subset of the sample space.

$P(E) = \frac{n(E)}{n(S)}$.

ex. Tossing a coin 3 times.

Event: Getting at least 2 heads.

$P(E) = \frac{4}{8} = 0.5$ or 50%. 4 outcomes.

Event: Getting no tails. $\longleftrightarrow$ getting all heads.

$P(E) = \frac{1}{8} = 0.125$ or 12.5%. 1 outcome.

Probability — Let S be a sample space in which every outcome is equally likely to occur; and let E be an event. Then the probability of E, or $P(E)$ is...

$$P(E) = \frac{n(E)}{n(S)}, \text{ where } n = \#\text{ of outcomes in...}$$

$= \frac{\text{part}}{\text{whole}}$.

* $n(E) \leq n(S)$, $n \geq 0$

numerator $\leq$ denominator

* the greatest probability is 1 or 100%
* the smallest probability is 0 or 0%.

$$0 \leq P(E) \leq 1$$

Ex. A 5-card hand is drawn from the standard 52-card deck. What is the probability that all 5 cards are spades?

Event

$$n(S) = {}_{52}C_5 = 2{,}598{,}960$$

$$n(E) = {}_{13}C_5 = 1287.$$

$$P(E) = \frac{n(E)}{n(S)} = \frac{1287}{2598960} = 0.0005$$

or

0.05%

Ex. From a bag of 20 tennis balls, 4 of them are known to be defective. If two of the balls are chosen at random, what is the probability that both of them are defective?

$n(S) = {}_{20}C_2 = 190$

$n(E_1) = {}_4C_2 = 6$

$P(E) = \frac{6}{190} \approx 0.032$ or 3.2%