Quantitative Skills & Reasoning – Math 1001

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Probability Unit

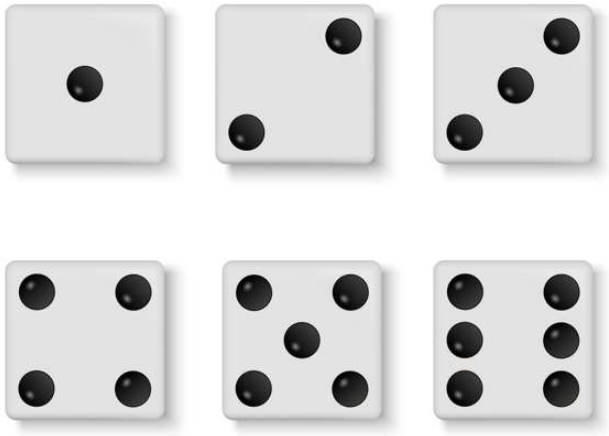
pp 279-282 in textbook

Definitions

- The result of an experiment is called an **outcome**.
- An **event** is any particular outcome or group of outcomes.
- A **simple event** is an event that cannot be broken down further.
- The **sample space** is the set of all possible simple events.

Example

When you roll a die, the sample space is {1, 2, 3, 4, 5, 6}. Rolling a two is a simple event. Rolling an odd number is **compound event**.



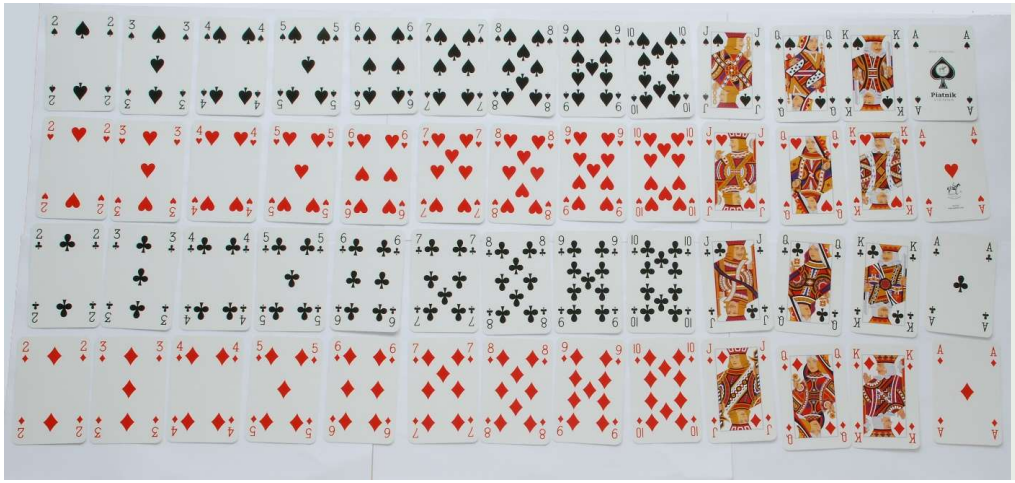
Example

When you draw a single card from a standard 52-card deck, the sample space is set of thirteen values:

{Ace, King, Queen, Jack, 10, 9, 8, 7, 6, 5, 4, 3, 2} for each of the four suits {Spades, Hearts, Clubs, Diamonds}.

Drawing the Queen of Diamonds is a ***simple event***.

Drawing a four is a ***compound event***.

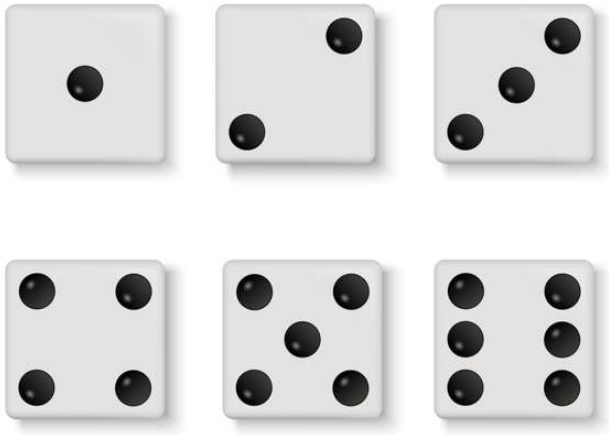


Definitions

- Given that all outcomes are equally likely, we can compute the probability of an event E using this formula:

$$P(E) = \frac{Number\ of\ outcomes\ corresponding\ to\ the\ event\ E}{Total\ number\ of\ equal\ likely\ outcomes}$$

Example



If we roll a 6-sided fair die, calculate:

- P(rolling a six) =

  P(rolling a six) = 1/6

- P(rolling an odd number) =

  P(rolling an odd number) = 3/6 = 1/2

Example

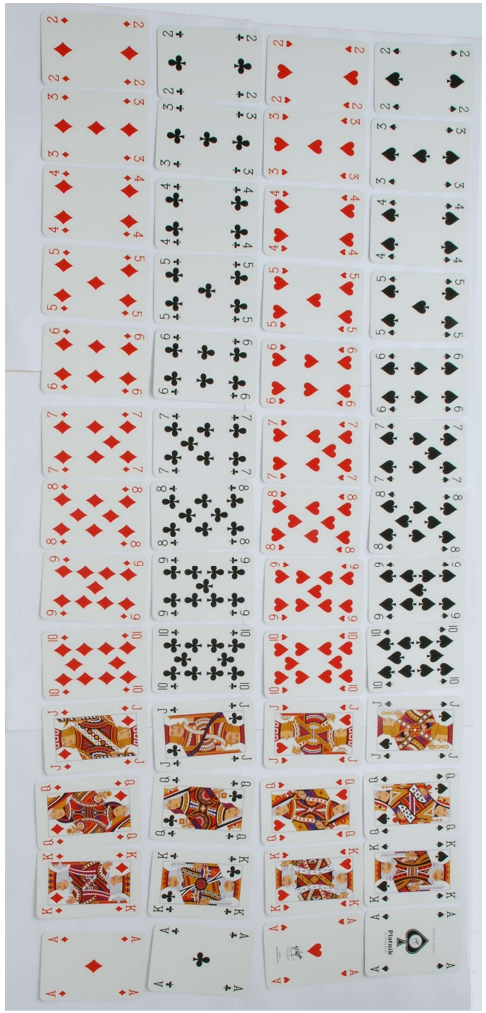
Given a standard deck of 52-card playing cards, calculate:

- P(drawing the Queen of Diamonds) =

  P(drawing the Queen of Diamonds) = 1/52

- P(drawing a four) =

  P(drawing a four) = 4/52 = 1/13



Example

A ball is drawn randomly from a jar that contains **6 red marbles, 2 white marbles, and 5 yellow marbles**. Find the probability of the given event.

a. A red marble is drawn

b. A white marble is drawn

Example

A ball is drawn randomly from a jar that contains **6 red marbles, 2 white marbles, and 5 yellow marbles**. Find the probability of the given event.

a. A red marble is drawn $\frac{6}{13}$

b. A white marble is drawn $\frac{2}{13}$

Definitions

- An ***impossible event*** has a probability of 0.
- A ***certain event*** has a probability of 1.

The probability of any event must be $0 \leq P(E) \leq 1$.

Definitions

- The ***complement*** of an event is the event "*E* does not happen." The notation $\bar{E}$ is used for the complement of event *E*.
- We can compute the probability of the complement using
- $P(\bar{E}) = 1 - P(E)$. Notice also that $P(E) = 1 - P(\bar{E})$.

Example

Compute the probability of rolling a 12-sided die and getting a number other than 8.

Steps:

1. P(8) = 1/12
2. P(not an 8) = $1 - \frac{1}{12} = \frac{11}{12}$

Definitions

- ***Odds*** is the ratio of the probability that a particular event will occur to the probability that it will not occur. We always express odds in simplest form.

The ***odds for*** an event *E* is the ratio of P(*E*) to P(*not E*).

The ***odds against*** an event *E* is the ratio of P(not *E*) to P(*E*).

Example

A card is drawn randomly from a standard 52-card deck. Find the following:

Odds in favor of drawing a face card

$$= \frac{\frac{12}{52}}{\frac{40}{52}} = \frac{12}{52} * \frac{52}{40} = \frac{12}{40} = \frac{3}{10} \rightarrow 3 \text{ to } 10$$

Odds against drawing a face card

$$= \frac{\frac{40}{52}}{\frac{12}{52}} = \frac{40}{52} * \frac{52}{12} = \frac{40}{12} = \frac{10}{3} \rightarrow 10 \text{ to } 3$$

Note: Odds Are Always Expressed As Integers

The Probability of an event occurring is P(E) = .85, P(Not E) = 1-.85 = .15

Odds in favor of Event E

$= \frac{.85}{.15} = \frac{85}{15} = \frac{17}{3} \rightarrow$ 17 to 3

Odds against event E

$= \frac{.15}{.85} = \frac{15}{85} = \frac{3}{17} \rightarrow$ 3 to 17

In homework, if you have P as decimal, you will have to be sure you have integers in the final probability ratio.