8.1. Sample Space, Events, Probability.

Goals: ① Understand the concepts of a sample space, an event, an outcome, and a random experiment.

② Calculate the probability of simple events.

Random Experiment.

Definition: A random experiment is a process which produces a number of possible outcomes. Outcomes cannot be predicted with absolute certainty.

E.g. ① Experiment: toss a fair coin once.

Possible outcomes: H or T

② Experiment: toss a 2 fair coins once.

Possible outcomes: HH, TT, HT, TH

③ Experiment : pick a card at random from a

52 - card - deck

How many different outcomes? 52 possible outcomes.

④ Experiment : Roll a dice :

Possible outcomes : $1, 2, 3, 4, 5, 6$.

⑤ Experiment : Roll a pair of dice

Possible outcomes : $(1,1); (1,2); \ldots; (1,6)$

$(2,1); (2,2); \ldots, (2,6)$

$\vdots$

$(6,1); (6,2); \ldots (6,6)$

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Sample Space: The sample space of a random experiment is the set whose elements are the possible outcomes of that experiment.

E.g. Experiment: toss a fair coin once

Sample Space $S = \{H, T\}$

Experiment: toss a pair of fair coin once.

$$S = \{HH, TT, HT, TH\}$$

Experiment: roll a dice once

$$S = \{1, 2, 3, 4, 5, 6\}.$$

Event: An event is a subset of a sample space.

E.g. Roll a dice once

$$S = \{1, 2, 3, 4, 5, 6\}$$

E is the event that I get an odd number.

$$E = \{1, 3, 5\} \longrightarrow \text{subset of } S.$$

E.g. Toss 2 coins once

    Event E : I get exactly 1 head

$$E = ? \quad \{HT, TH\}$$

    Event F : I get at least 1 tail

$$F = ? \quad \{HT, TH, TT\}.$$

E.g. Experiment: Pick a card from a 52-card-deck.

    A = event I get a red card

    B = event I get a King

$$n(A) \overset{?}{=} 26 \quad ; \quad n(B) = 4$$

Definition: S: sample space of a random experiment

E: is an event. (subset of S)

The probability of the event E, denoted by,

$P(E)$ is calculated by:

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

$$= \frac{\# \text{ of elements in } E}{\# \text{ of elements in } S}.$$

Ex. Experiment: roll 2 dice.

E is the event that the sum of the 2 dice is 7.

Find $P(E)$?

F : event that we get the same # on both
        dice

Find $P(F)$