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$N \equiv$ total # of possible outcomes

$M_A, M_B \cdots \equiv$ # of outcomes falling into category A, B ...

$P_A, P_B \cdots \equiv \frac{M_A}{N}, \frac{M_B}{N} \cdots$

$$P_A \equiv \frac{M_A}{N}$$

Probability of outcome belonging to category A.

Since $N = M_A + M_B + \cdots$

$$P_A = \frac{M_A}{M_A + M_B + \cdots}$$

$$0 \leq P \leq 1$$

Example: Rolling a die

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

"P" of getting a "2" in a single die roll ?

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$A \equiv$ getting 2
$N = 6$
$N_A = 1$
$\Rightarrow p_A = \frac{1}{6}$

Relationships among events

① mutually exclusive events (ME) — one outcome precludes all the others.

example — $A \equiv$ getting 2, $B \equiv$ getting 3 } possible outcomes when rolling a die.

A and B can not occur at the same time.

② collectively exhaustive events (CE)

- - if they represent an entire set of possibilities: no other events are possible

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Example — head and tail is a set of CE events, when tossing a coin.

③ Independent Events (IE) — if the different outcomes are not related to each other.

Example: Results of multiple die rolls are IEs.

Note: Typically events are not IEs and ME at the same time.

Example: a single coin toss: ME but not IEs.
multiple coin tosses: IE but not ME.

Multiplicity of events:

possible outcomes { A_1 A_2 A_3 ...
B_1 B_2 B_3 ...

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multiplicity is the total # of ways in which all different outcomes can be combined.

example: A: car color B: car model

$M_A = 3$ $M_B = 2$

$$W = M_A \cdot M_B = 3 \times 2 = 6$$

Combination of Events

Addition Rule: consider ME

OR case: i.e., either 1 event occur or another

example: roll a die. Probability (Prob.) of getting a 2 or a 3?

$$P_{(A \text{ or } B \text{ or } \cdots)} = \frac{M_A + M_B + \cdots}{N} = P_A + P_B + \cdots$$

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$P_{A \text{ or } B} = P_A + P_B = \frac{1}{6} + \frac{1}{6} = \frac{1}{3}$

If events are ME and CE, then $P = P_A + P_B + \cdots = 1$

Multiplication Rule: Consider IE

AND case (i.e., consider them "together")

$P_{(A \text{ and } B \text{ and } \cdots)} = \frac{M_A}{N} \cdot \frac{M_B}{N} \cdot \cdots$

$= P_A \cdot P_B \cdots$

example: get 2 and 3 in 2 die roll.