# Basic Probability Rules

**Rule 1**: $0 \leq P(A) \leq 1$ for any event $A$

**Rule 2**: $P(S) = 1$

**Rule 3**: Iff $A$ and $B$ are disjoint then
$P(A \cup B) = P(A) + P(B)$

**Rule 4**: $P(A^c) = 1 - P(A)$

**Rule 5**: Iff $A$ and $B$ are independent then

$$P(A \cap B) = P(A) \cdot P(B)$$

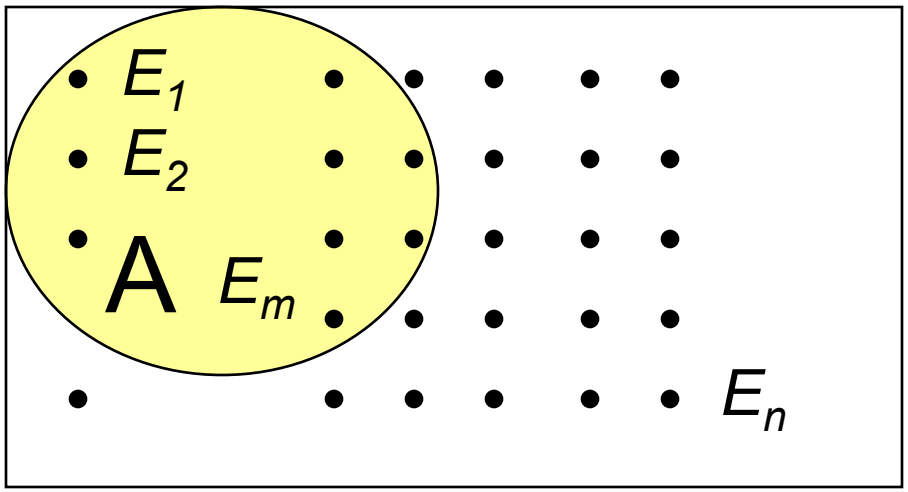
Note: Iff = If and only if

# Calculating the Probability of an Event

**Probabilities in a Finite Sample Space**:

1. Assign probabilities to all simple events $E_1, E_2, \ldots E_n$
2. Suppose the event *A* consists of (is the union of) the simple events $E_1, E_2, \ldots E_m$, *then*

$$P(A) = \sum_{i=1}^{m} P(E_i)$$



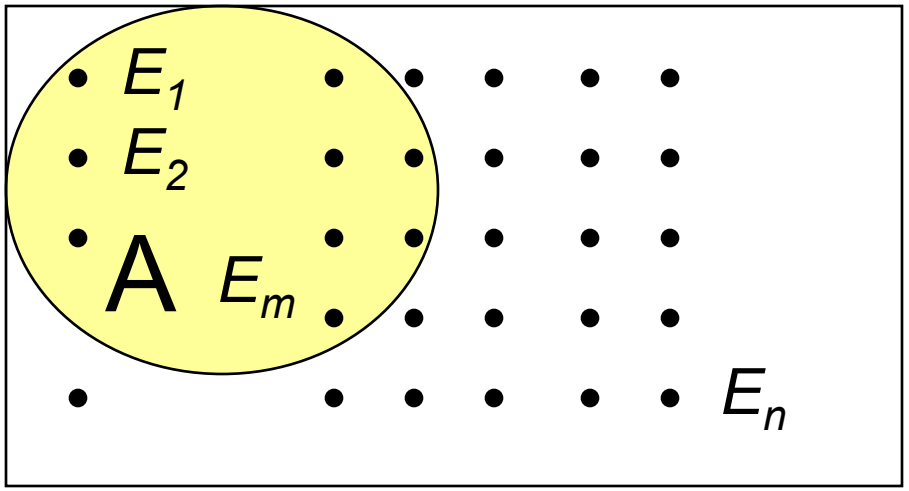
# Calculating the Probability of an Event

**Special Case: Sample Space with Equally Likely Simple Events**

1. $P(E_i) = \frac{1}{n}$

2. Suppose the event *A* consists of *m* simple events $E_1, E_2, \ldots E_m$, then

$$P(A) = \frac{m}{n}$$



# CASE: Rolling Dice

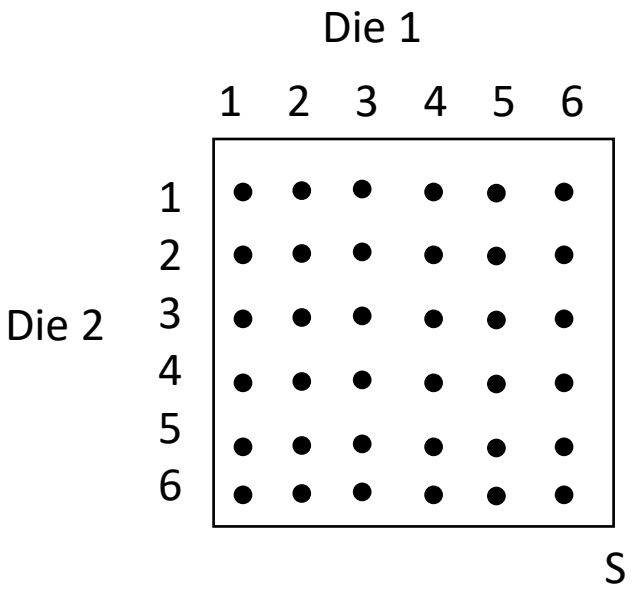
## Roll two balanced dice

Sample Space?

Events:
**A = A pair of 6's is rolled**
**B = At least one 3 is rolled**
**C = The sum of dots equals 5**

Probability:

| | |
|---|---|
| P(A) = | P($A^c$) = |
| P(B) = | P(A ∩ B) = |
| P(C) = | P(B U C) = |




Are A and B independent? Disjoint?

Are B and C independent? Disjoint?

# Probabilities versus Odds

<u>Coin Toss</u>

Odds of tossing a head is 1:1

Probability of tossing a head is $\frac{1}{2}$


<u>Roll a Die</u>

Odds of rolling a six is 1:5

Probability of rolling a six is $\frac{1}{6}$

<u>Lightning Strike</u>

If odds of getting struck by lightning is 1:9 billion

Then probability of getting struck by lightning is $\frac{1}{9{,}000{,}000{,}001}$