

## Counting

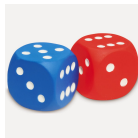
- Introduction and Applications
- Sum and Product Rule
- The Complement Rule
- Inclusion-Exclusion Principle
- The Pigeon-Hole Principle
- Permutations and Combinations
- Combinatorial Proofs
- Permutation and Combinations with Repetitions

# Complement Principle

To count the elements in a set  $A$ , find  $|\bar{A}|$

Suppose I roll a red and blue dice!

In how many outcomes the dice show different values?



$A_i$  = set of outcomes with

red die shows  $i$  and the blue die shows something else

$S$  = set of outcomes where the dice show different values

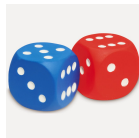
$$|S| = \left| \bigcup_{i=1}^6 A_i \right| = \sum_{i=1}^6 |A_i| = \sum_{i=1}^6 5 = 30$$

## Complement Principle

To count the elements in a set  $A$ , find  $|\bar{A}|$

Suppose I roll a red and blue dice!

In how many outcomes the dice show different values?



$S$  = set of outcomes where the dice show different values

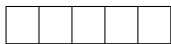
$B$  = set of outcomes where the dice agree

$$|S| = 36 - |B|$$

$$|S| = 36 - 6 = 30$$

# Complement Principle

**ICP 11-10** How many 5 digits postal codes are there with at least one repetition?



How many 5 digits postal codes are there?

$$(10)^5$$

How many 5 digits postal codes are there with no repetition?

$$10 \cdot 9 \cdot 8 \cdot 7 \cdot 6$$

$$| \text{All codes} | - | \text{codes with no repetition} |$$

$$\underbrace{10^5}_{\text{All}} - \underbrace{10 \cdot 9 \cdot 8 \cdot 7 \cdot 6}_{\text{codes with no repetition}}$$