Axioms of Probability

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The Axioms of probability:

Axiom 1 (Non negativity) $P(A) \geq 0 \;\forall\, A$

Axiom 2 (Normalisation) $P(\Omega) = 1$

Axiom 3 (finite additivity) If the events A1, A2, A3, ……, An are mutually disjoint then $P(A_1 \cup A_2 \cup A_3 \cup A_n) = \sum_i^n P(A_i)$

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Axioms of Probability

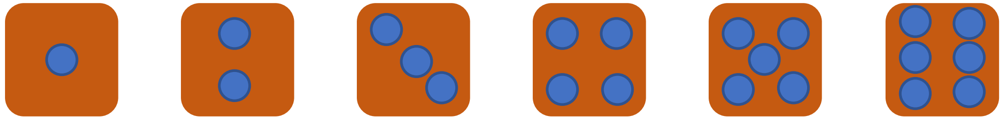
The Axioms of probability:

Axiom 3 **If the events A1, A2, A3, ……, An are mutually disjoint then P(A1 ∪ A2 ∪ A3 ∪ An) =** $\sum_i^n P(A_i)$

(finite additivity)

Compute probabilities of large events from small events

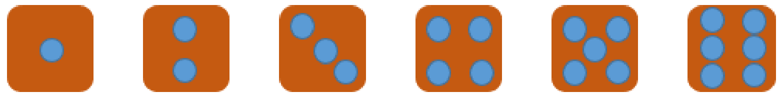
Smallest possible event = one outcome



A1 A2 A3 A4 A5 A6

Axioms of Probability

The Axioms of probability:



A1 A2 A3 A4 A5 A6

Given P(A1), P(A2), P(A3), P(A4), P(A5), P(A6)

We can compute other probabilities

B: that event that the outcome is and odd no.

P(B) = P(A1) + P(A3) + P(A5),

C: that event that the outcome is ≥ 5.

P(C) = P(A5) + P(A6)

D: that event that the outcome is $multiple\ of\ 3$.

P(D) = P(A3) + P(A6)

Axioms of Probability

Some properties of probability:

Property 1:

$$\boxed{P(A) = 1 - P(A^C)}$$

$A \cup A^C = \Omega$

$P(\Omega) = 1 = P(A \cup A^C) = P(A) + P(A^C) = 1$

Therefore $P(A) = 1 - P(A^C)$

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Some properties of probability:

Property 2:

P(A) $\leq$ 1

$P(A) = 1 - P(A^C)$

We know that A^C is always greater then zero

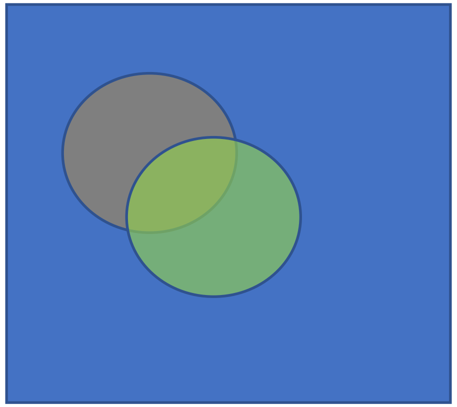
orzd

Therefore $P(A) = 1 - P(A^C)$ *Because* $P(A^C)$ *can not be zero*

$P(A) \leq 1$

Axioms of Probability

Some properties of probability:



Property 3:

$$\mathbf{P}(A \cup B) = \boldsymbol{P}(\boldsymbol{A}) + \boldsymbol{P}(\boldsymbol{B}) - \boldsymbol{P}(A \cap B)$$

$$\mathbf{P}(A \cup B) = P\left(A \cup (B \cap A^C)\right)$$

$$= \boldsymbol{P}(\boldsymbol{A}) + P(B \cap A^C)$$

$$= \boldsymbol{P}(\boldsymbol{A}) + \mathbf{P(B)} - P(B \cap \boldsymbol{A})$$

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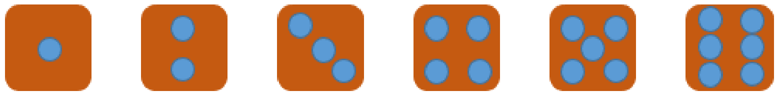
Axioms of Probability

Some properties of probability:



A1 A2 A3 A4 A5 A6

Property 4:

The **sum of the probability of all outcomes is equal to 1**

$$P(\Omega) = P(A_1 \cup A_2 \cup A_3 \cup A_4 \cup A_5 \cup A_6)$$

$$= \sum_{i=1}^{n} P(A_i) = 1$$

Axioms of Probability

Some properties of probability:

Property 5:

$\mathbf{P}(\phi) = \mathbf{0}$

$\mathbf{P}(\Omega) = \boldsymbol{P}(\Omega \cup \phi) = \boldsymbol{P}(\Omega) + \boldsymbol{P}(\phi) = \mathbf{1}$

$\boldsymbol{P}(\phi) = \mathbf{1} - \boldsymbol{P}(\Omega) = \mathbf{0}$