Probability review for sequence modeling

Ben Langmead

TODO

This video

Sample space

Event

Joint probability

Conditional probability

Multiplication rule

Independence

Next...

Conditional independence

Markov assumption

Probability

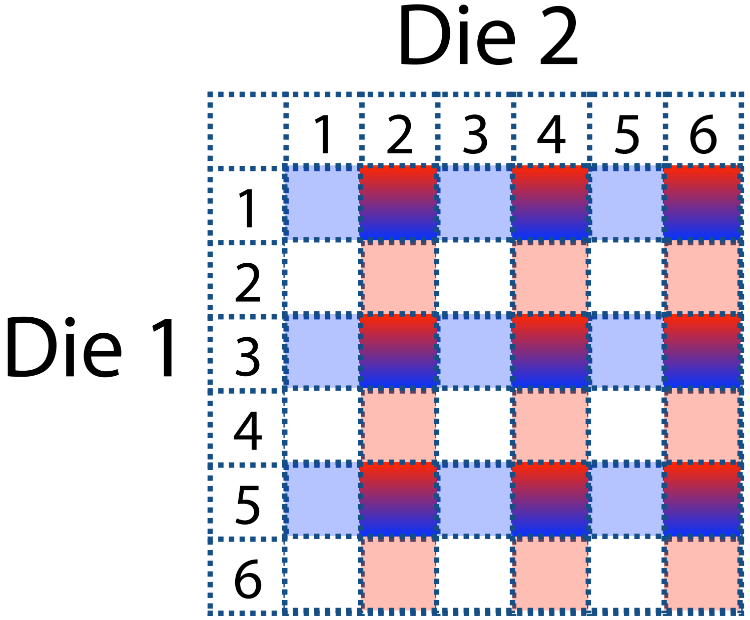
Sample space (Ω) is ***set*** of all possible outcomes

E.g. Ω = { all possible rolls of 2 dice }

An *event* is a ***subset*** of Ω

A = { rolls where 1st die is odd }

B = { rolls where 2nd die is even }



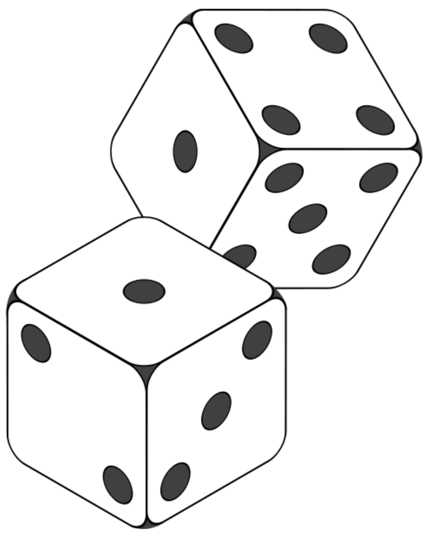
$P(A)$: fraction of outcomes that are in *A* *

$$P(A) = |A| / |\Omega| = 18/36 = 0.5$$

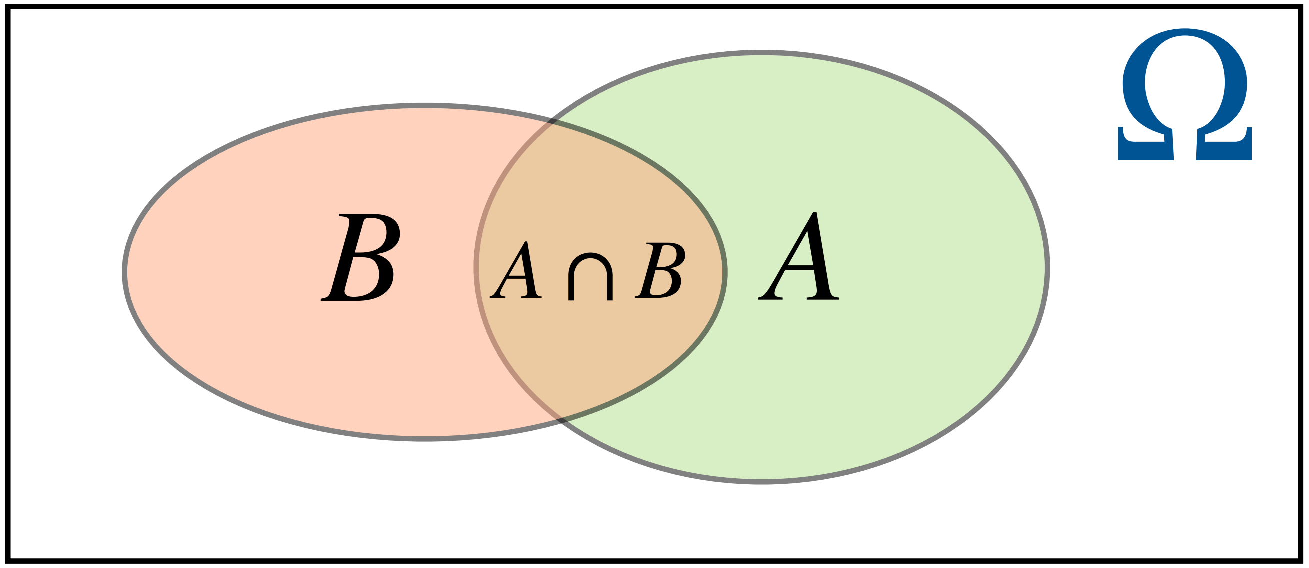
** Naively assuming all outcomes are equiprobable*

Probability

$P(A, B)$: fraction of outcomes in ***both*** A and B



$P(A, B) =$



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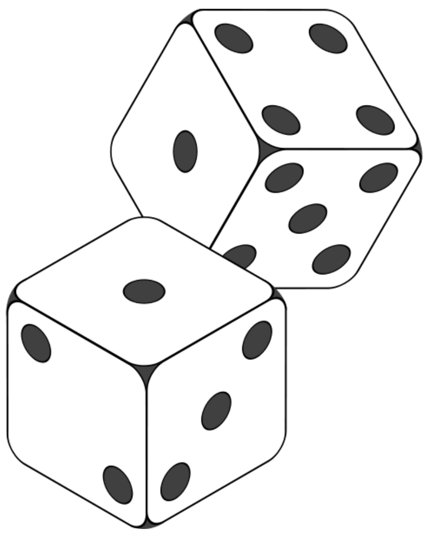
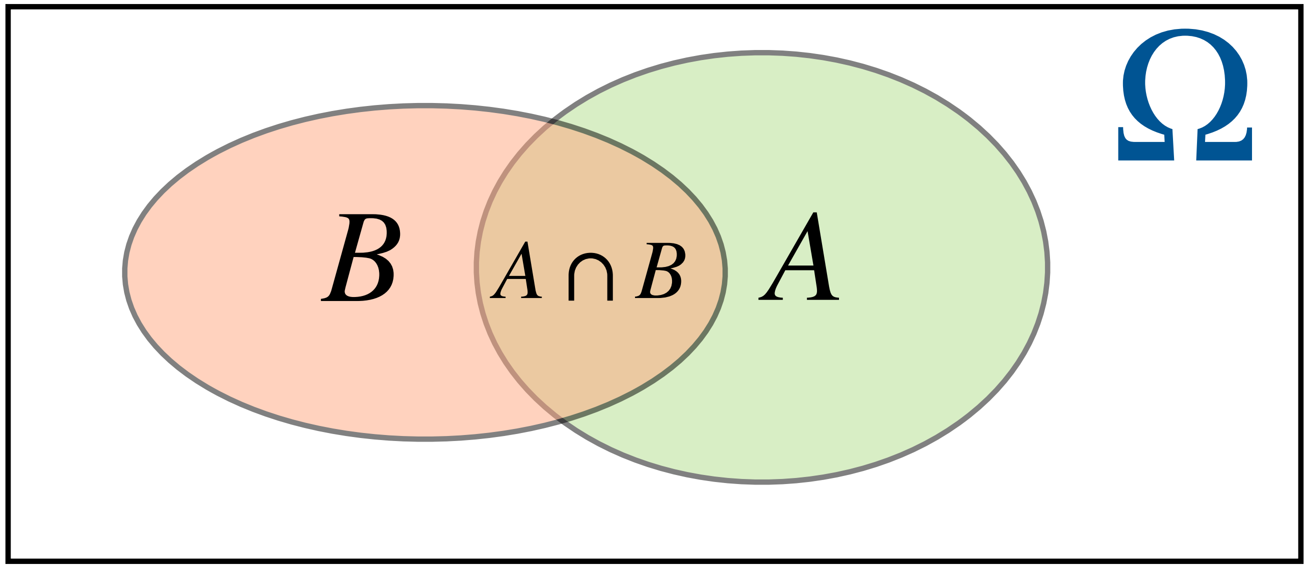


$P(A, B) = |A \cap B| / |\Omega| = 9 / 36 = 0.25$

Also written: $P(A \cap B)$ or $P(AB)$

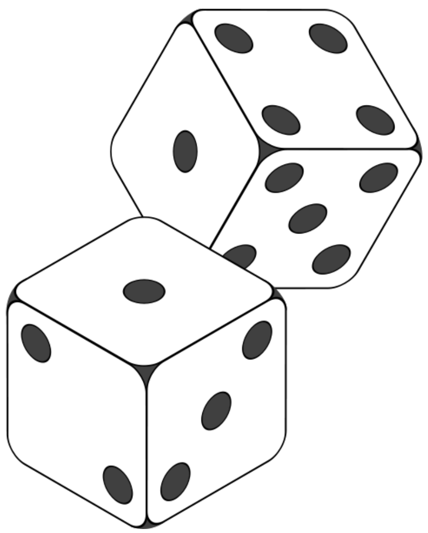
Joint probability of *A* and *B*



Probability

$P(A \mid B)$: fraction of outcomes in B that are also in A

conditional probability of A *given* B



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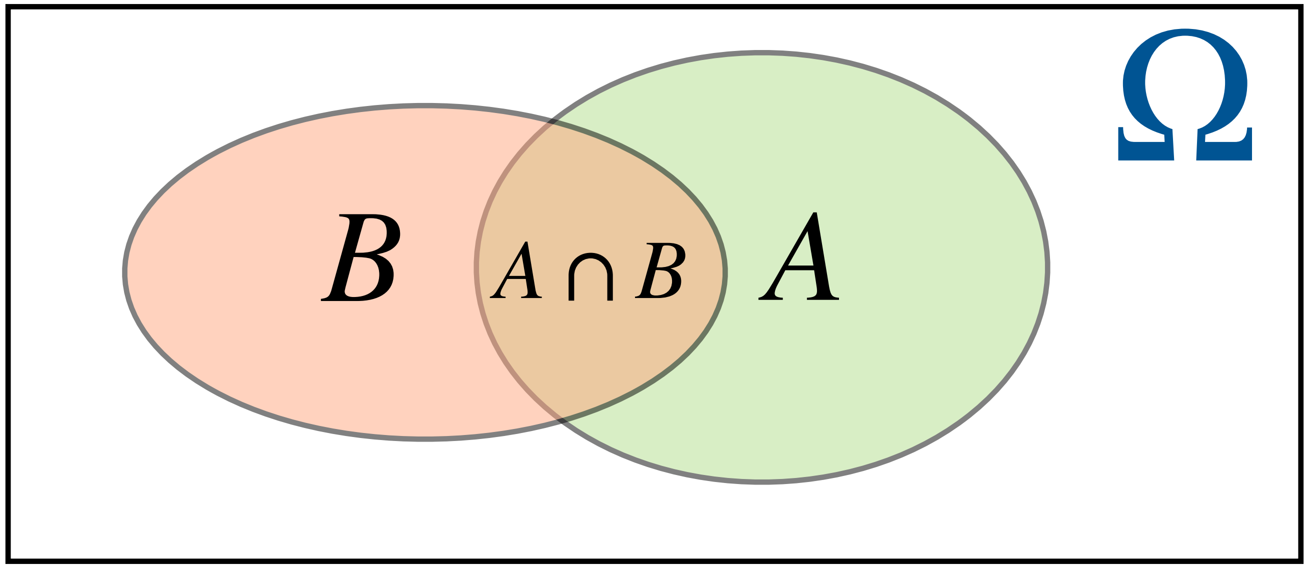

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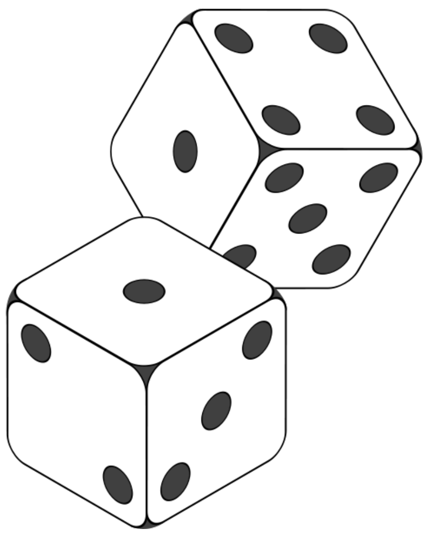

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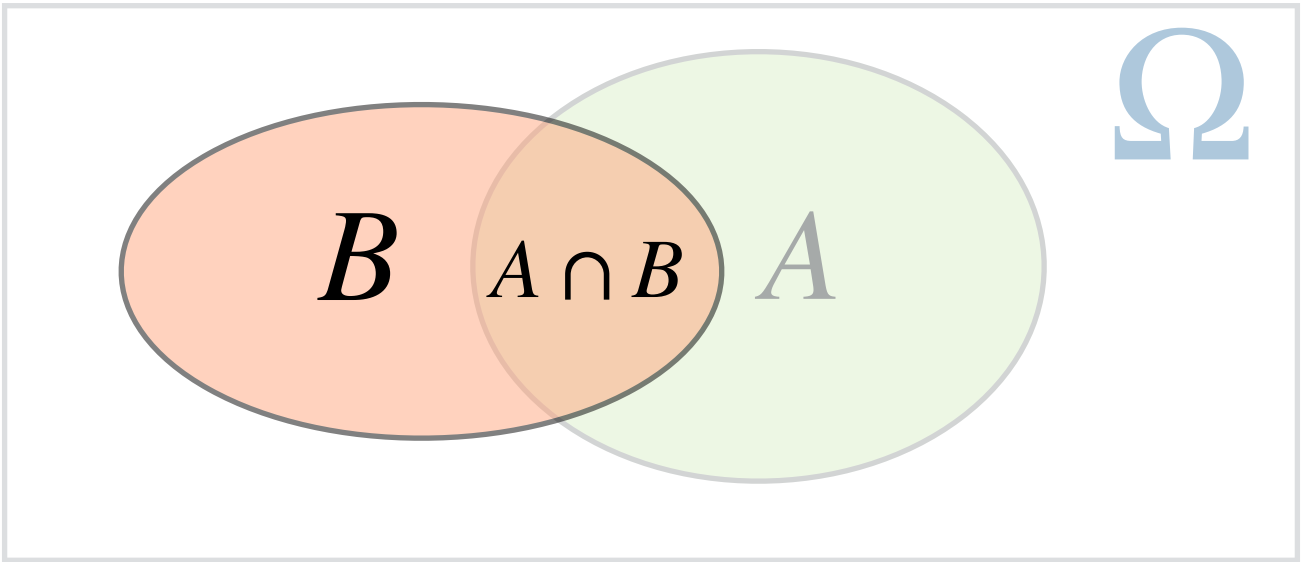

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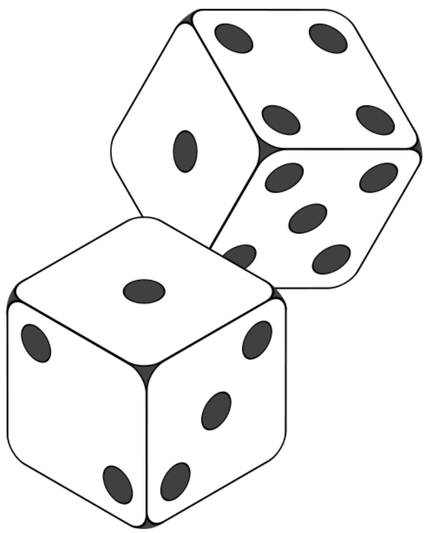

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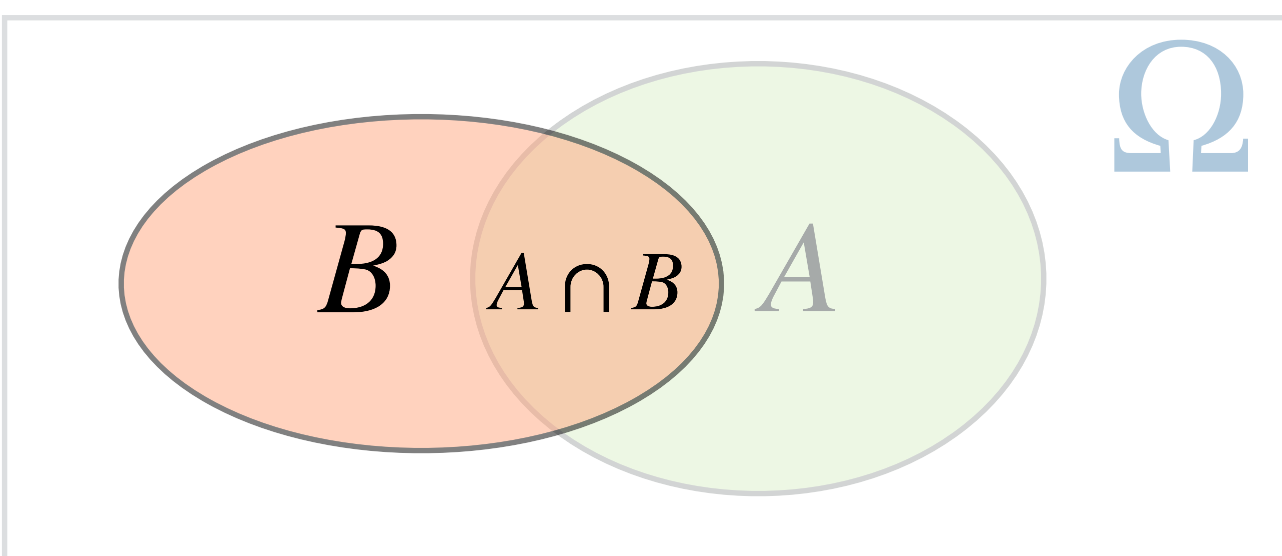

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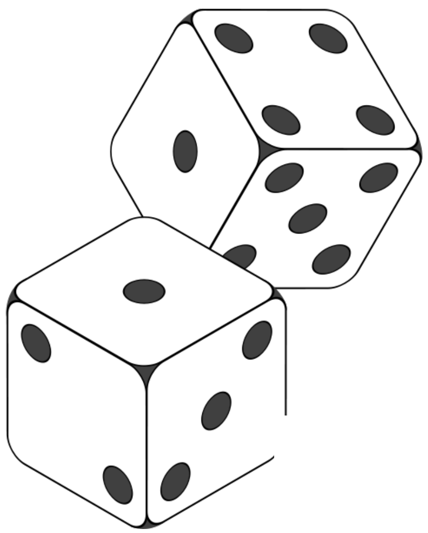

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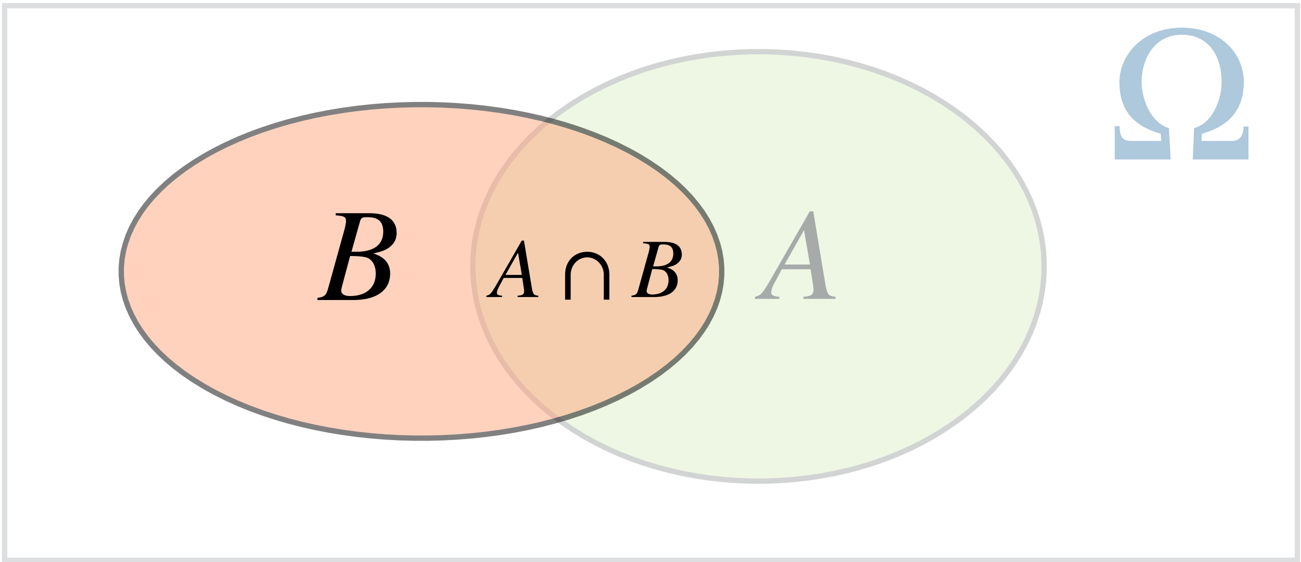

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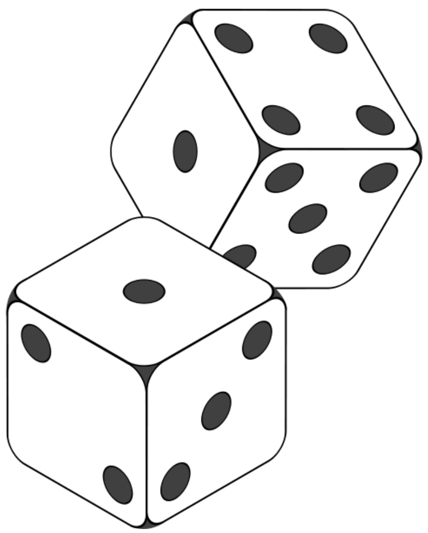

$$P(A \mid B) = P(A, B) / P(B)$$

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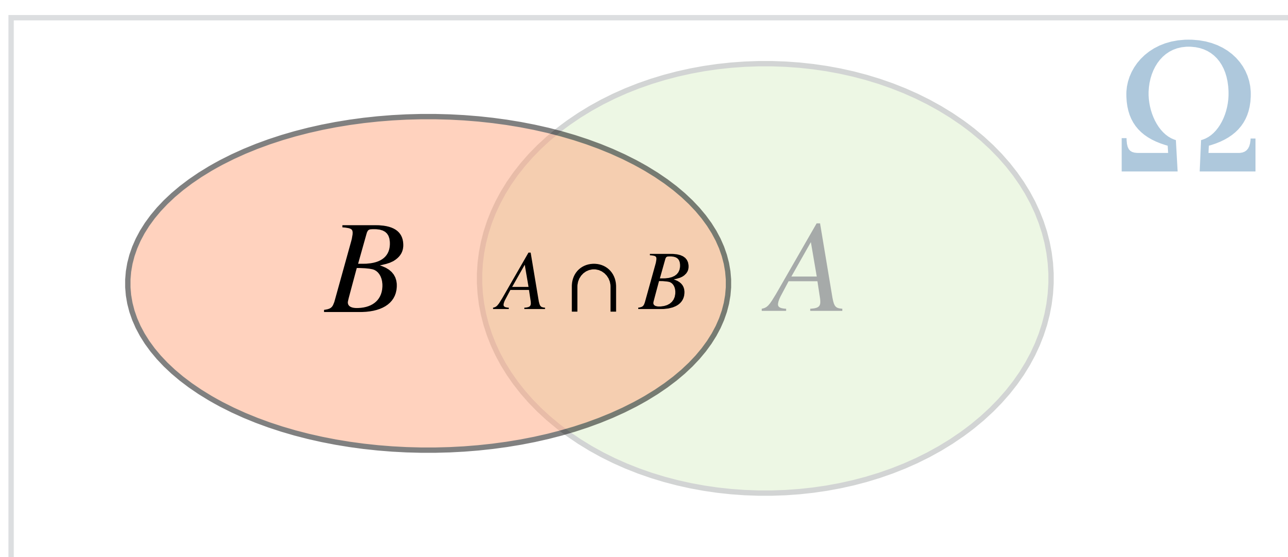

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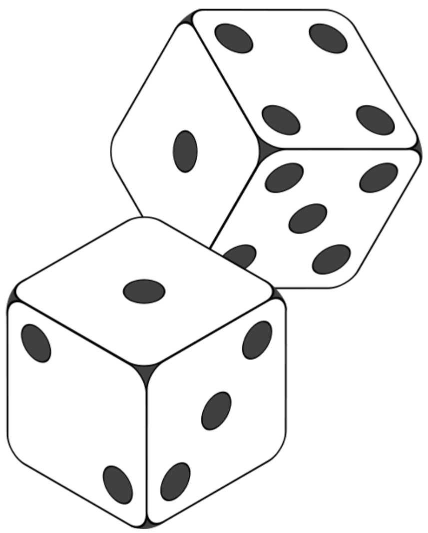
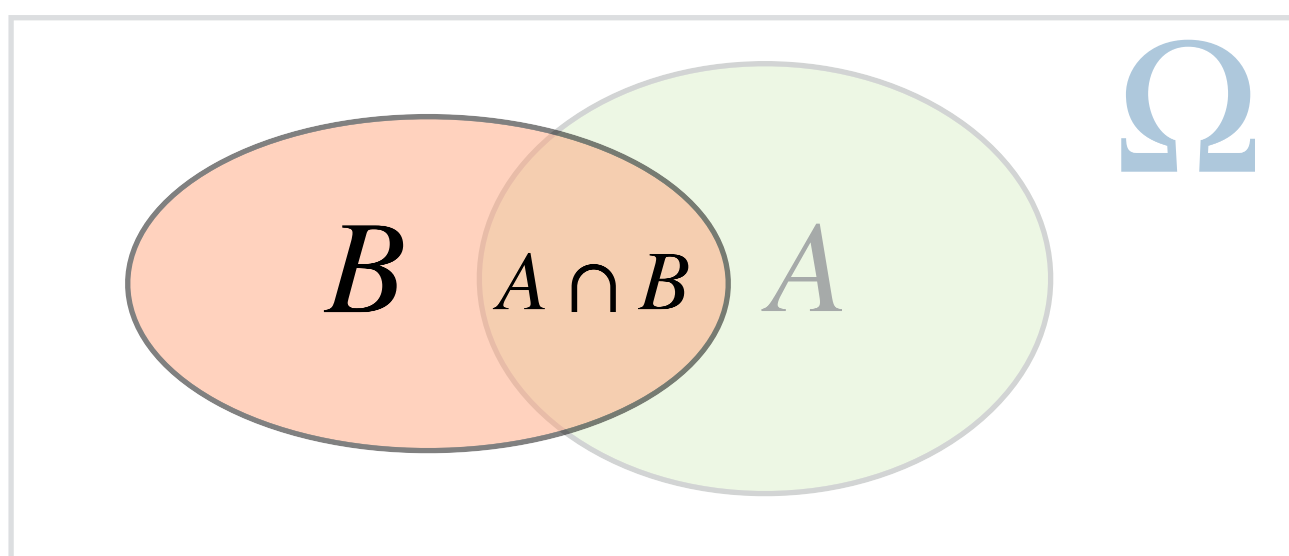


$$P(A \mid B) = P(A, B) / P(B)$$

$$P(A, B) = P(A \mid B) \cdot P(B) \leftarrow \textit{multiplication rule}$$



Probability

Multiplication rule for joint prob with many variables:

$$P(A, B, C, D) =$$

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$$P(A, B, C, D) = P(A \mid B, C, D) \cdot P(B, C, D)$$

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joint probability

conditional probabilities

marginal prob

Probability

When A & B are independent *events*

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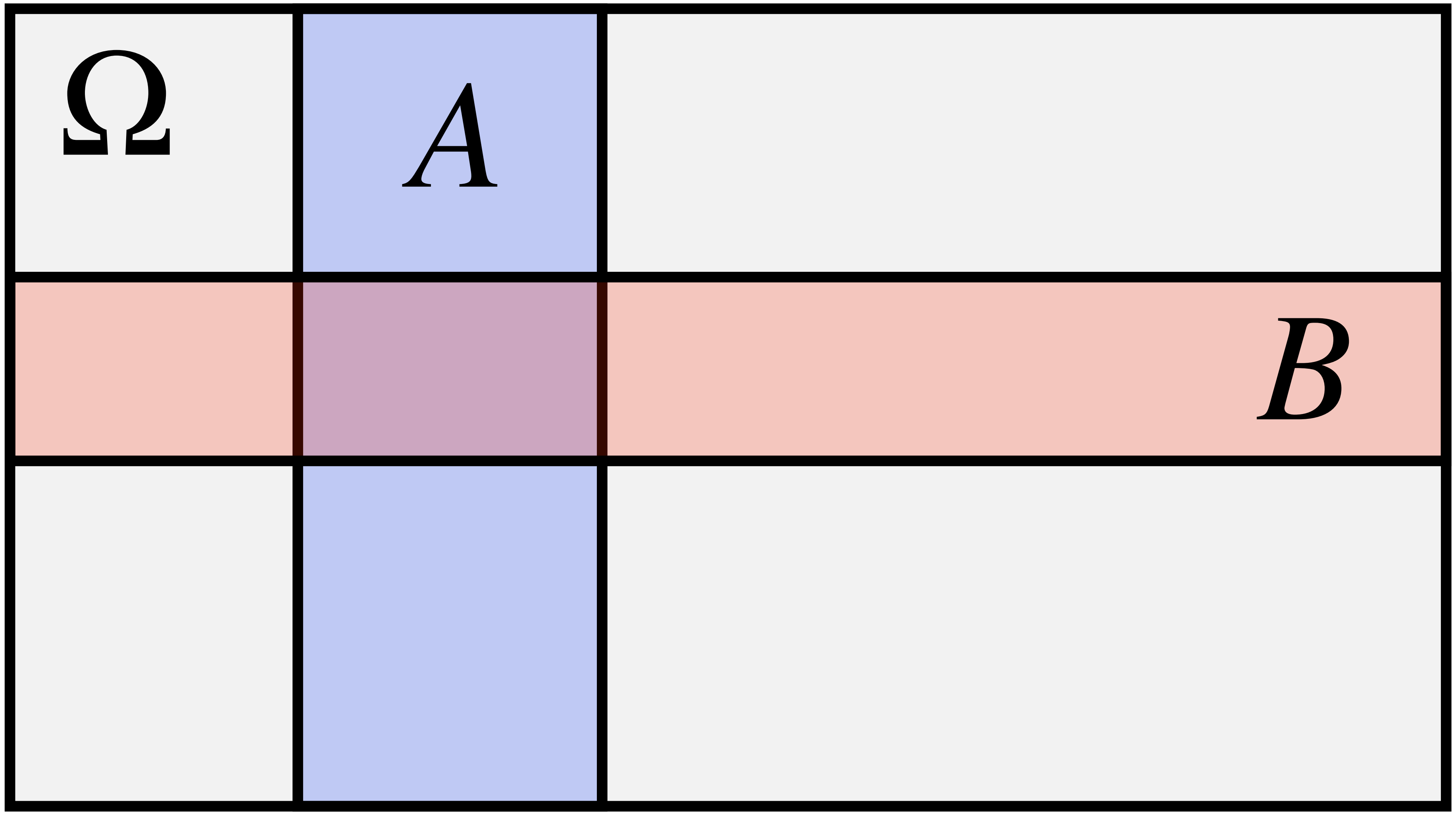
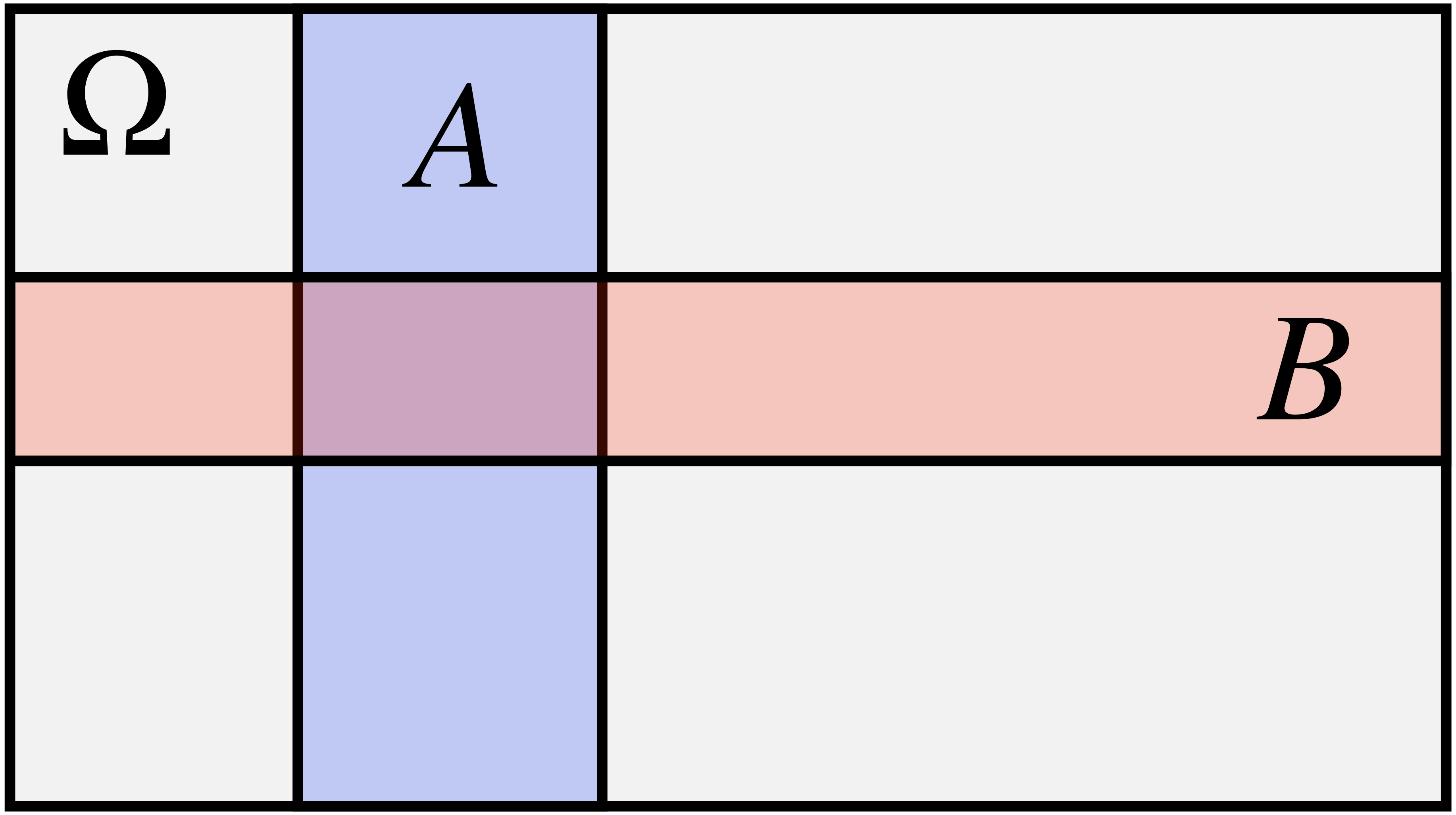


Probability

When A & B are independent *events*



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Probability

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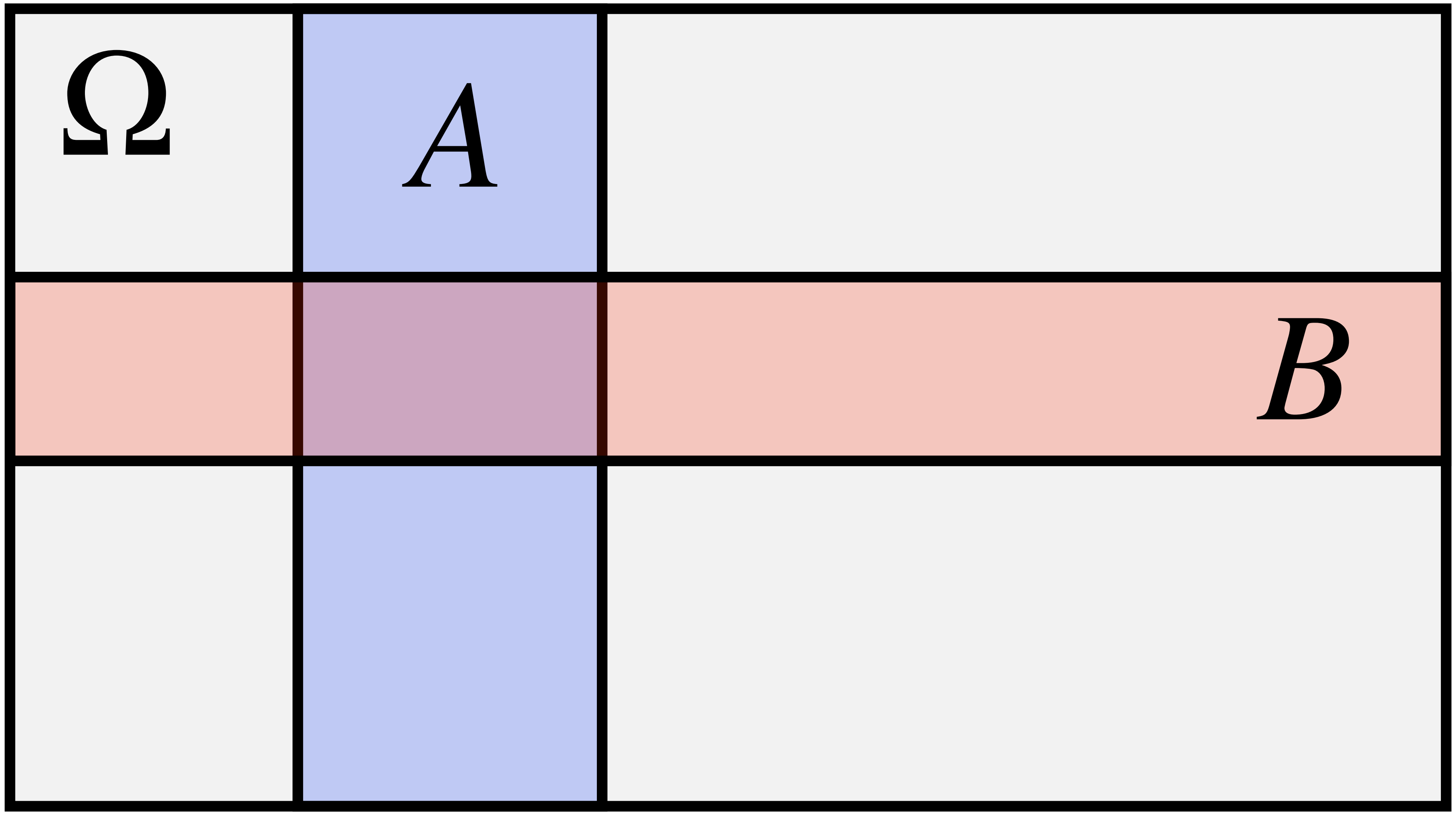
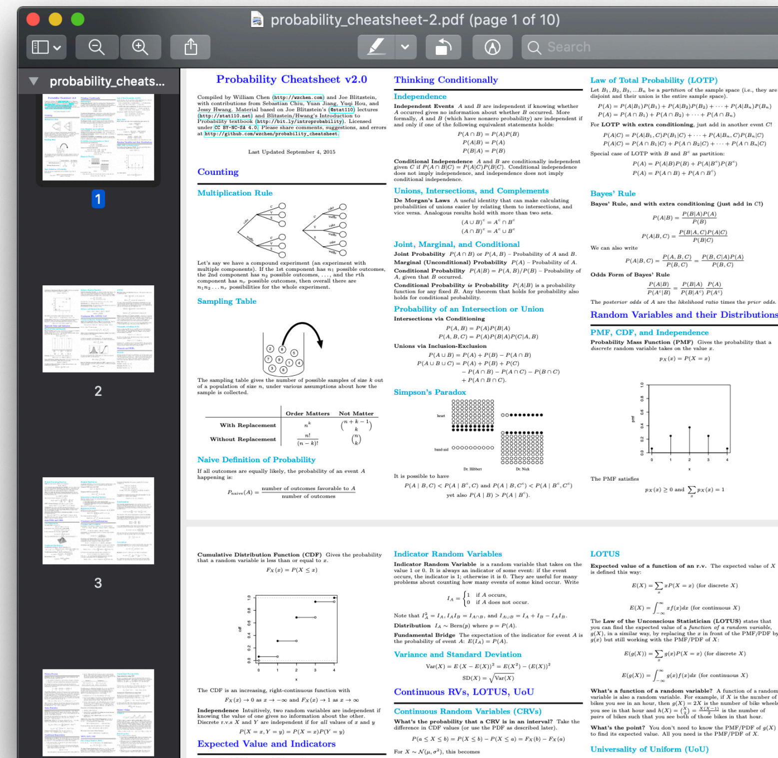


$$P(A, B) = P(A) \cdot P(B)$$

$$P(A \mid B) = \frac{P(A, B)}{P(B)} = P(A)$$

Probability

Blitzstein: Probability
(Harvard Stat 110)



Blitzstein & Chen's "cheat sheet"