Conditional Probability and Bayes Theorem

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Conditional Probability

$$P(\ D_2 = 2 \mid D_1 + D_2 \leqslant 5)$$

Conditional Probability

$P(D_2=2 \mid D_1 + D_2 \leqslant 5)$

Event 1: $D_1 + D_2 \leqslant 5$

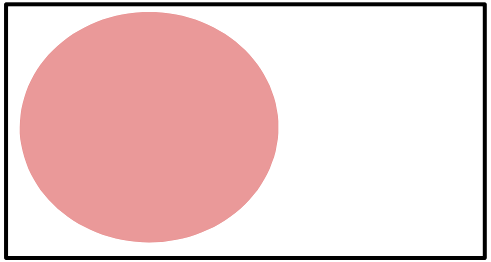
Event 2: $D_2=2$

Conditional Probability

$P(D_2=2 \mid D_1 + D_2 \leqslant 5)$

Event 1: $D_1 + D_2 \leqslant 5$

Event 2: $D_2=2$



$P(E_1)$

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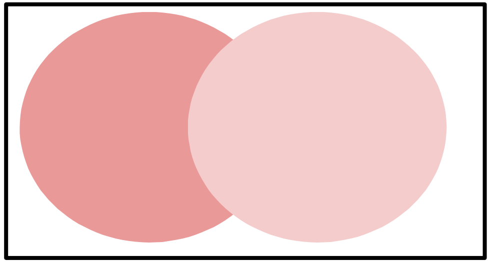
Conditional Probability

$$P(\ D_2=2 \mid D_1 + D_2 \leqslant 5)$$

Event 1: $D_1 + D_2 \leqslant 5$

Event 2: $D_2=2$



$P(\ E_1)$ $P(\ E_2)$

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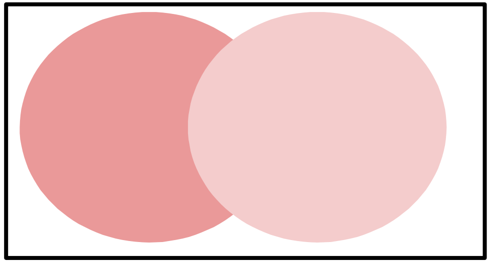
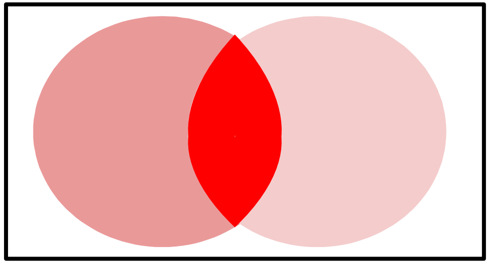
Conditional Probability

$P(D_2=2 \mid D_1 + D_2 \leqslant 5)$

Event 1: $D_1 + D_2 \leqslant 5$
Event 2: $D_2=2$



$P(E_1)$ $P(E_2)$



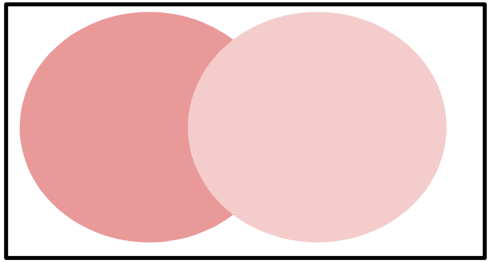
$P(E_1 \cap E_2)$

Conditional Probability

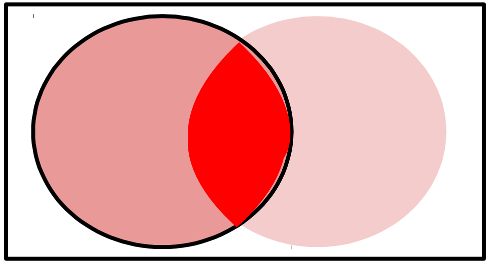
$P(\ D_2=2 \mid D_1 + D_2 \leqslant 5)$

Event 1: $D_1 + D_2 \leqslant 5$

Event 2: $D_2=2$



$P(\ E_1)$ $P(\ E_2)$



$P(\ E_1 \cap E_2)$

$$P(E_2 \mid E_1) = \frac{P(E_1 \cap E_2)}{P(\ E_1)}$$

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Conditional Probability

$$P(E_2 \mid E_1) = \frac{P(E_1 \cap E_2)}{P(E_1)}$$

D1 →

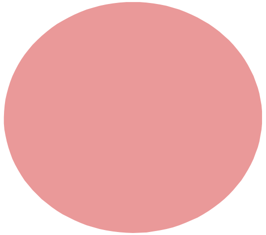
D2 ↓

	1	2	3	4	5	6
1	2	3	4	5	6	7
2	3	4	5	6	7	8
3	4	5	6	7	8	9
4	5	6	7	8	9	10
5	6	7	8	9	10	11
6	7	8	9	10	11	12

Conditional Probability

$$P(E_2 \mid E_1) = \frac{P(E_1 \cap E_2)}{P(\ E_1\ )}$$

$$P(E_1) = 10/36$$



D1 →

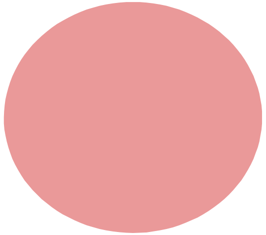
D2 ↓

	1	2	3	4	5	6
1	2	3	4	5	6	7
2	3	4	5	6	7	8
3	4	5	6	7	8	9
4	5	6	7	8	9	10
5	6	7	8	9	10	11
6	7	8	9	10	11	12

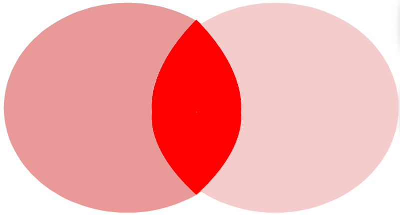
Conditional Probability

$$P(E_2 \mid E_1) = \frac{P(E_1 \cap E_2)}{P(E_1)}$$

$P(E_1) = 10/36$



$P(E_1 \cap E_2) = 3/36$



D1 →

D2 ↓

	1	2	3	4	5	6
1	2	3	4	5	6	7
2	3	4	5	6	7	8
3	4	5	6	7	8	9
4	5	6	7	8	9	10
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Conditional Probability

$$P(E_2 \mid E_1) = \frac{P(E_1 \cap E_2)}{P(E_1)}$$

$$P(D_2 = 2 \mid D_1 + D_2 \leqslant 5) = \frac{3/36}{10/36}$$

D1 →

D2 ↓

	1	2	3	4	5	6
1	2	3	4	5	6	7
2	3	4	5	6	7	8
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Conditional Probability

$$P(E_2 \mid E_1) = \frac{P(E_1 \cap E_2)}{P(E_1)}$$

$$P(D_2=2 \mid D_1+D_2 \leqslant 5) = \frac{3/36}{10/36}$$

$$= 0.3$$

D1 →

D2 ↓

	1	2	3	4	5	6
1	2	3	4	5	6	7
2	3	4	5	6	7	8
3	4	5	6	7	8	9
4	5	6	7	8	9	10
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Conditional Probability

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Conditional Probability

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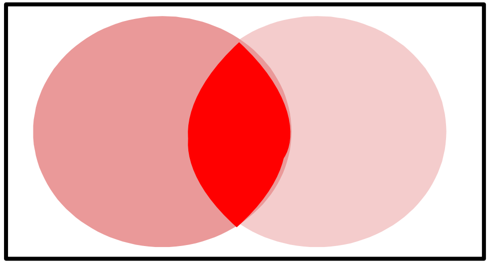
Conditional Probability

$$P(E_2 \mid E_1) = \frac{P(E_1 \cap E_2)}{P(E_1)}$$

$$P(E_1 \mid E_2) = \frac{P(E_2 \cap E_1)}{P(E_2)}$$



$P(E_1 \cap E_2)$

Conditional Probability

$$P(E_2 \mid E_1) = \frac{P(E_1 \cap E_2)}{P(E_1)} = \frac{P(E_2 \cap E_1)}{P(E_1)}$$

$$P(E_1 \mid E_2) = \frac{P(E_2 \cap E_1)}{P(E_2)}$$

Conditional Probability

$$P(E_2 \mid E_1) = \frac{P(E_1 \cap E_2)}{P(E_1)} = \frac{P(E_2 \cap E_1)}{P(E_1)}$$

$$P(E_1 \mid E_2) = \frac{P(E_2 \cap E_1)}{P(E_2)} \Rightarrow P(E_2 \cap E_1) = P(E_1 \mid E_2) * P(E_2)$$

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Conditional Probability

$$P(E_2 \mid E_1) = \frac{P(E_1 \cap E_2)}{P(E_1)} = \frac{P(E_2 \cap E_1)}{P(E_1)} = \frac{P(E_1 \mid E_2) * P(E_2)}{P(E_1)}$$

$$P(E_1 \mid E_2) = \frac{P(E_2 \cap E_1)}{P(E_2)} \Rightarrow P(E_2 \cap E_1) = P(E_1 \mid E_2) * P(E_2)$$

Conditional Probability

$$\boxed{P(E_2 \mid E_1)} = \frac{P(E_1 \cap E_2)}{P(E_1)} = \frac{P(E_2 \cap E_1)}{P(E_1)} = \boxed{\frac{P(E_1 \mid E_2) * P(E_2)}{P(E_1)}}$$

$$P(E_1 \mid E_2) = \frac{P(E_2 \cap E_1)}{P(E_2)} \Rightarrow P(E_2 \cap E_1) = P(E_1 \mid E_2) * P(E_2)$$

Bayes Theorem

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$$P(E_1 \mid E_2) = \frac{P(E_2 \mid E_1) * P(E_1)}{P(E_2)}$$

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