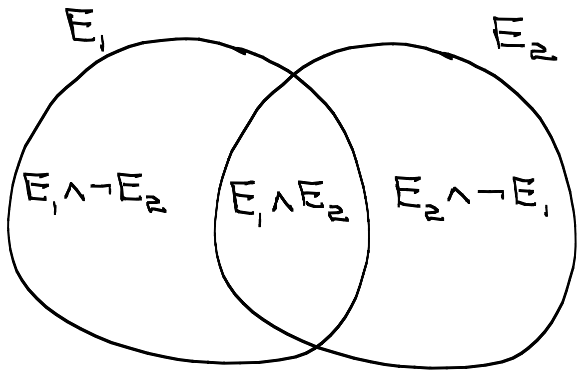
1.1

Venn diagram for events E_1 and E_2 $\underbrace{(E_1 \wedge E_2 \neq \phi)}_{E_1 \text{ and } E_2 \text{ are not exclusive}}$

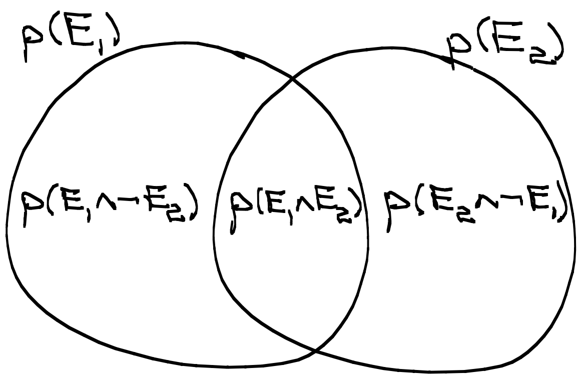


Both circles: $E_1 \vee E_2$

Complement of both circles:

$$\neg(E_1 \vee E_2) = \neg E_1 \wedge \neg E_2$$

That probabilities are a measure on the space of events means that we can regard the area occupied by an event as representing its probability.



Both circles: $p(E_1 \vee E_2)$

Complement of both circles:

$$p(\neg(E_1 \vee E_2)) = p(\neg E_1 \wedge \neg E_2)$$

The diagram practically shouts out how to show what we want:

$$\left.\begin{array}{l}(E_1 \wedge E_2) \wedge (E_1 \wedge \neg E_2) = \phi \\ (E_1 \wedge E_2) \vee (E_1 \wedge \neg E_2) = E_1\end{array}\right. \underset{\text{axiom 3}}{\Longrightarrow} p(E_1) = p(E_1 \wedge E_2) + p(E_1 \wedge \neg E_2)$$

$$\left.\begin{array}{l}E_2 \wedge (E_1 \wedge \neg E_2) = \phi \\ E_2 \vee (E_1 \wedge \neg E_2) = E_1 \vee E_2\end{array}\right. \underset{\text{axiom 3}}{\Longrightarrow} p(E_1 \vee E_2) = p(E_2) + p(E_1 \wedge \neg E_2)$$

Subtract to get $\boxed{p(E_1 \vee E_2) - p(E_1) = p(E_2) - p(E_1 \wedge E_2)}$