This page; Bayes's next theorem; random variables

\[ P(A) = \sum_{j=1}^{k} P\left( (A \text{ and } B_j) \cup (A \text{ and } B_{j+1}) \cup \ldots \cup (A \text{ and } B_k) \right) \]

\[ = P(\overline{A} \text{ and } B_i) + P(A \text{ and } B_i) \]

\[ + \ldots + P(A \text{ and } B_k) \]

\[ = P(B_i) P(A|B_i) + P(B_k) P(A|B_k) \]

\[ + \ldots + P(B_k) P(A|B_k) \]

\[ = \sum_{j=1}^{k} P(B_j) P(A|B_j) = P(A) \]
\[ P(A \text{ and } B | C) = P(A | C) \cdot P(B | C) \]

independent given \( C \)
Bayes's Theorem for events (T/F propositions)

1750's village in rural England data: unusually large # of people in village died in last month (c) cause - effect (d) data

Q: why? what's the cause of this data?

possible causes:
- bad food
- bad water
- bad air
disease

causal inference

deterministic causation: hammer always falls down

probabilistic causation: some but not all people die from

(c) cause - effect (d) data
\[ P(\text{cause} | \text{effect}) \quad \text{harder if we want} \]

\[ P(\text{effect} | \text{cause}) \quad \text{easier} \]

\[
P(C | E) = P(E | C)
\]

Bayes' Theorem, among others.