Bayes' theorem

Let A and B two events (**Outcomes**) , Probability of A given B happened

$$P(A|B) = \frac{p(A \cap B)}{P(B)}$$

- Called **Conditional Probability**

The **Bayes** Theorem: $P(B|A) = ?$

- B is an event **hard to measure** (expansive and cost efforts and money)
- A is an event **easy to measure** (Cheap and easy)

$$P(B|A) = \frac{P(A|B)P(B)}{P(A)}$$

- $P(B|A) \to$ Posterior
- $P(B) \to$ Prior
- $P(A|B) \to$ Update

We use $P(B)$ as a base information and we use " The **easy to measure** $P(A|B)$" to **update** $P(B) \to P(B|A)$.
So the more information we gather $P(B|A) \to$ will replace $P(B)$ as the base information

Without $P(A)$:

$$P(B|A) = \frac{P(A|B)P(B)}{P(A|B)P(B) + P(A|B^c)P(B^c)}$$

Generalized Byes' Theorem :

$$P(B_j|A) = \frac{P(A|B_j)P(B_j)}{\sum P(A|B_j)P(B_j)}$$