Bayesian Theorem:

A way of finding probabilities when we know certain other probabilities

The formula is

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

(conditional probability)

$P(A|B)$: Probability of A given B, probability of A given that B happens

$P(A)$: Probability of A

$P(B|A)$: Probability of B given A.

$P(B)$: Probability of B

Proof:

The probability of 2 events happening, $P(A \cap B)$ is probability of A, $P(A)$ times the probability of B given that A has occured, $P(B|A)$

$$P(A \cap B) = P(A) \cdot P(B|A) \quad \rightarrow (1)$$

Also, $$P(A \cap B) = P(B) \cdot P(A|B) \quad \rightarrow (2)$$

Equating 1 & 2 yields

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

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