

## Conditional probability

How can we calculate the result in a case where two events are not independent. It means that, if one event occurs it will directly affect the probability for the other event?

If event A and B are those kind of complex events which will not exclude each other. In this case we have a so-called conditional probability (event A affects event B).

Notation:  $p(A | B)$

In this case we mean the relative frequency which compares the sum of all probability to the probability of event B (probability of its occurrence).

$$p(A|B) = \frac{k_{AB}}{k_B} = \frac{\frac{k_{AB}}{k}}{\frac{k_B}{k}} = \frac{p(A \cap B)}{p(B)}$$

So we can get to the conclusion:

$$p(A \cap B) = p(A|B) p(B)$$

1.)  $p(A \cap B)$ : This represents the probability that both events A and B occur simultaneously. It is also known as the probability of the intersection of A and B.

2.)  $p(A|B)$ : This is the conditional probability of event A occurring given that event B has already occurred. It tells us how likely A is to happen under the condition that B has happened.

### What the Formula Says?

The formula states that the probability of both events A and B occurring together, is equal to the probability of B occurring multiplied by the probability of A occurring given that B has already occurred.

### Example:

A manufacturer needs to produce a shaft with two critical dimensions: length (L) and diameter (D). Tolerances of  $\pm \Delta$  is allowed. After inspecting 180 components, the results are as follows:

Measurement Result	Quantity
Faultless	162
The length is faulty	10
The diameter is faulty	12
Both dimensions are faulty	4
Only the length is faulty	6
Only the diameter is faulty	8

**Question:** What are the probabilities of events  $(A)$  and  $(B)$ :

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