Explain Bayes Theorem in detail.

In [probability theory](https://en.wikipedia.org/wiki/Probability_theory) and [statistics](https://en.wikipedia.org/wiki/Statistics), **Bayes’ theorem** (alternatively **Bayes’ law** or [Bayes' rule](https://en.wikipedia.org/wiki/Bayes%27_rule" \o "Bayes' rule)) describes the [probability](https://en.wikipedia.org/wiki/Probability) of an [event](https://en.wikipedia.org/wiki/Event_(probability_theory)), based on conditions that might be related to the event. For example, if cancer is related to age, then, using Bayes’ theorem, a person’s age can be used to more accurately assess the probability that they have cancer.

One of the many applications of Bayes’ theorem is [Bayesian inference](https://en.wikipedia.org/wiki/Bayesian_inference), a particular approach to [statistical inference](https://en.wikipedia.org/wiki/Statistical_inference). When applied, the probabilities involved in Bayes’ theorem may have different [probability interpretations](https://en.wikipedia.org/wiki/Probability_interpretation). With the [Bayesian probability](https://en.wikipedia.org/wiki/Bayesian_probability) interpretation the theorem expresses how a subjective degree of belief should rationally change to account for evidence. Bayesian inference is fundamental to [Bayesian statistics](https://en.wikipedia.org/wiki/Bayesian_statistics).

**Bayes' theorem.** Let A1, A2, ... , An be a set of mutually exclusive events that together form the sample space S. Let B be any event from the same sample space, such that P(B) > 0. Then, 

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| P( Ak | B ) = | P( Ak ∩ B )  P( A1 ∩ B ) + P( A2 ∩ B ) + . . . + P( An ∩ B ) |

Note: Invoking the fact that P( Ak ∩ B ) = P( Ak )P( B | Ak ), Baye's theorem can also be expressed as 

|  |  |
| --- | --- |
| P( Ak | B ) = | P( Ak ) P( B | Ak )  P( A1 ) P( B | A1 ) + P( A2 ) P( B | A2 ) + . . . + P( An ) P( B | An ) |