

Bayes' Theorem clearly explained! 🚀

It's the probability of event B given A has occurred

The prior probability of event A

$$\text{Posterior } P(A|B) = \frac{\text{Likelihood } P(B|A) * \text{Prior } P(A)}{\text{Evidence } P(B)}$$

It's the probability of event A given B was observed

The probability of observing B



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Imagine you're trying to guess if it will rain today. 🌧️ You start with a general belief based on the weather forecast (say, a 40% chance of rain).

This is your 'prior' probability:

Swipe ... ➡️



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Prior probability: The general belief!



$$P(\text{Rain}) = 40\%$$

It's the probability of an event before new evidence is taken into account.

It represents what is known about the event's likelihood before observing any new data or information.



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Then, you notice the sky is getting cloudy. ☁️

This new information is 'evidence' that might affect the probability of rain.

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The evidence!



$$P(\text{Clouds}) = 50\%$$

Let's assume it's 50% or 0.50 for simplicity.

This includes all scenarios –
both when it rains and when it does not.



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Next we consider $P(\text{Cloud} \mid \text{Rain})$, which is used to weigh the likelihood that it rains when it's cloudy.

Check this out 🙌

Swipe ... 🙌



The likelihood!



$$P(\text{Clouds}|\text{Rain}) = 80\% = L(\text{Rain}|\text{Clouds})$$

The probability of observing clouds given that it's raining!

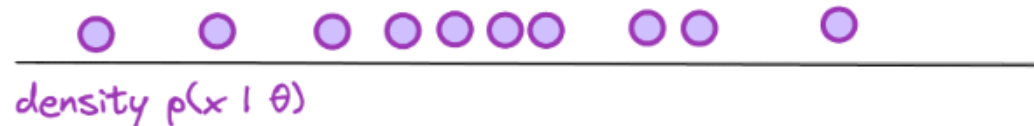
It can also be interpreted as the Likelihood it rains given clouds are there $L(\text{Rain}|\text{Clouds})$!

Although it sounds similar to $P(\text{Rain}|\text{Clouds})$, the likelihood function here is used in Bayes' Theorem to weigh the evidence (clouds) in support of our hypothesis (rain), rather than calculating a straightforward probability.

→ Likelihood function



Sampling Distribution θ (mean 0, standard deviation 1)



$L(\theta | x)$

We are now ready to update our belief by calculating the probability of rain given it's cloudy using Bayes' Theorem!

Check it out 🙏

Swipe ... 🙏



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Posterior probability: Updating our belief!

$$P(\text{🌂} \mid \text{☁️})$$

$$P(\text{Rain} \mid \text{Cloud}) = \frac{P(\text{Cloud} \mid \text{Rain}) * P(\text{Rain})}{P(\text{Cloud})}$$

$$= \frac{0.8 * 0.4}{0.5} = 0.64$$

Observe that our updated probability rises from 0.40 to 0.64, based on the new evidence!



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I'll leave you with a visual proof of the
Bayes' Theorem!

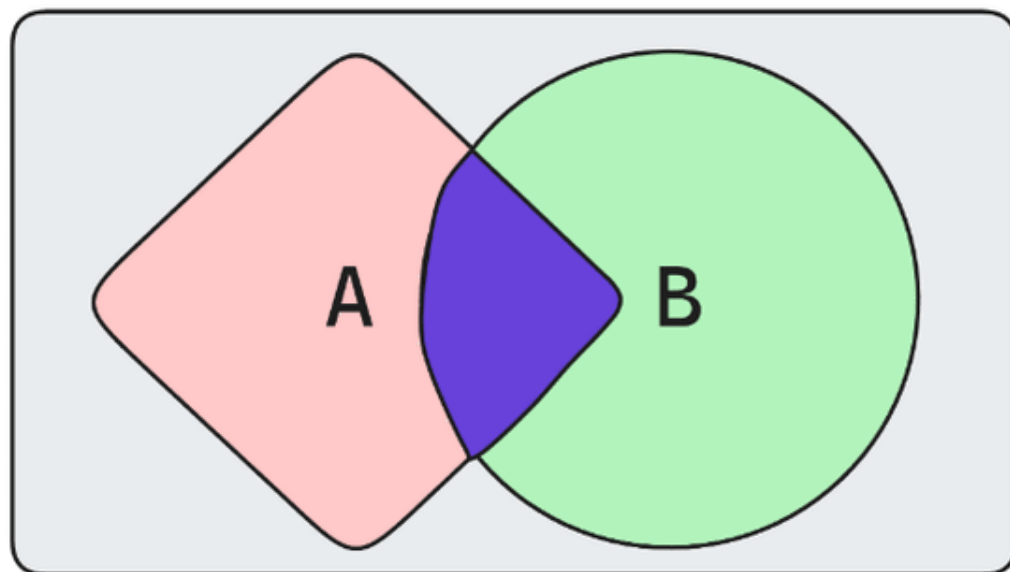
I hope you'll enjoy it!

Swipe ... 



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Visual proof of Bayes' Theorem!



$$P(A) = \frac{\text{red diamond}}{\text{gray rectangle}}$$

$$P(B) = \frac{\text{green circle}}{\text{gray rectangle}}$$

$$P(A|B) = \frac{\text{purple triangle}}{\text{green circle}}$$

$$P(B|A) = \frac{\text{purple triangle}}{\text{red diamond}}$$

$$\frac{\text{purple triangle}}{\text{green circle}} = P(A|B) = \frac{P(B|A) * P(A)}{P(B)} = \frac{\frac{\text{purple triangle}}{\text{red diamond}} * \frac{\text{red diamond}}{\text{gray rectangle}}}{\frac{\text{green circle}}{\text{gray rectangle}}} = \frac{\text{purple triangle}}{\text{green circle}}$$

The diagram illustrates the visual proof of Bayes' Theorem. It shows the relationship between the probability of A given B, the probability of B given A, the probability of A, and the probability of B. The final result shows that the probability of A given B is equal to the probability of B given A multiplied by the probability of A, divided by the probability of B.

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