

Bayes' rule with 3 variables

Asked 4 years, 6 months ago Active 4 years, 6 months ago Viewed 13k times

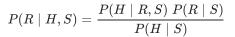


I have been using Sebastian Thrun's course on AI and I have encountered a slightly difficult problem with probability theory.



He poses the following statement:







I understand he used Bayes' Rule to get the RHS equation, but fail to see how he did this. If somebody could provide a breakdown of the application of the rule in this problem that would be great.

probability bayes-theorem

edited May 14 '15 at 5:51

Mike Pierce

14.2k 10 43 9

asked May 14 '15 at 5:48

slyaer **181** 1 1

2 Answers



Taking it one step at a time:

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$$P(R \mid H, S) = \frac{P(R, H, S)}{P(H, S)}$$

$$= \frac{P(H \mid R, S) P(R, S)}{P(H, S)}$$

$$= \frac{P(H \mid R, S) P(R \mid S) P(S)}{P(H, S)}$$

$$= \frac{P(H \mid R, S) P(R \mid S)}{P(H \mid S)} \frac{P(S)}{P(S)}$$

$$= \frac{P(H \mid R, S) P(R \mid S)}{P(H \mid S)}$$

answered May 14 '15 at 8:24





You don't really need Bayes' Theorem. Just apply the definition of conditional probability in two ways. Firstly,

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$$P(R \mid H, S) = rac{P(R, H \mid S)}{P(H \mid S)}$$

$$\therefore P(R, H \mid S) = P(R \mid H, S)P(H \mid S).$$

Secondly,

$$P(H \mid R, S) = rac{P(R, H \mid S)}{P(R \mid S)}$$

$$\therefore P(R, H \mid S) = P(H \mid R, S)P(R \mid S).$$

Combine these two to get the result.

answered May 14 '15 at 8:10



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- igwedge How to you get from P(R|H,S) to P(R,H|S)/P(H|S)? Mo Prog Jul 19 at 16:35 ightharpoonup ?
- @MoProg From the definition of conditional probability. Just as you can have $P(A \mid B) = P(A,B)/P(B)$, which is from the standard definition, you can also have $P(A \mid B,C) = P(A,B \mid C)/P(B \mid C)$, for events A,B,C. Mick A Jul 19 at 22:50
- Sorry @MickA, but I still don't understand how you use the definition of conditional probability P(X|Y) = P(X,Y)/P(Y) to get from P(A|B,C) to P(A,B|C)/P(B|C). If I use the definition of conditional probability I would have P(A|B,C) = P(A,B,C)/P(B,C), because I will substitute Y=B,C. Mo Prog Jul 22 at 7:57 \mathbb{Z}
- $\begin{tabular}{lll} @ MoProg We can derive it this way: & $\frac{P(A,B|C)}{P(B|C)} = \frac{P(A,B,C)/P(C)}{P(B,C)/P(C)} = \frac{P(A,B,C)}{P(B,C)} = P(A|B,C). Mick A Jul 22 at 13:59 \\ \end{tabular}$