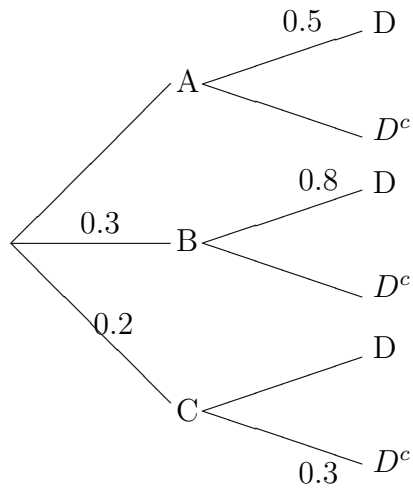


## 7.6: Bayes' Theorem

In Section 7.5 we've been calculating *a priori probabilities* - the likelihood an event will occur. In this section we are going to look at *a posteriori probabilities* - calculating probability after an outcome has been observed.

**Bayes' Theorem:**  $P(B|A) = \frac{P(A \cap B)}{P(A)}$ .

EXAMPLE 1. Using the tree diagram below, find:



(a)  $P(D^c)$

(b)  $P(D)$

(c)  $P(D|C)$

(d)  $P(C|D)$

EXAMPLE 2. *Box A has 5 purple, 3 yellow, and 7 red items in it. Box B has 4 yellow and 6 red items in it. An item is drawn from Box A and transferred to Box B. An item is then drawn from Box B. The color of item drawn from each box is recorded.*

(a) *Draw a tree diagram representing this experiment.*

(b) *What is the probability that both items are purple?*

(c) *What is the probability that the item drawn from the box A was yellow or the item drawn from the Box B was red?*

(d) *What is the probability that the item drawn from the box B is purple if the item drawn from the Box A was yellow?*

(e) *What is the probability that the transferred item was red if a yellow item was selected from the Box B?*

EXAMPLE 3. *Two cards are drawn from a deck of 52. What is the probability the 1st card is a face card, given that the 2nd card is an ace?*

EXAMPLE 4. *If a certain disease is present, then a blood test will reveal it 95% of the time. But the test will also indicate the presence of the disease 2% of the time when in fact the person tested is free of that disease; that is, the test gives a false positive 2% of the time. If 0.3% of the general population actually has the disease, what is the probability that a person chosen at random from the population*

(a) *has the disease given that he/she tested positive?*

(b) *does not have the disease given that they took the test twice and got positive results both times.*

## EXAMPLE 5.

<i>Age Group</i>	<i>% of Insured Drivers</i>	<i>Accident rate, %</i>
<i>Under 25</i>	<i>16</i>	<i>5.5</i>
<i>25-44</i>	<i>40</i>	<i>2.5</i>
<i>45-64</i>	<i>30</i>	<i>2</i>
<i>65+</i>	<i>14</i>	<i>4</i>

*What is the probability that an insured driver selected at random*

*(a) will be involved in an accident?*

*(b) who is involved in an accident is under 25?*