AY 250: Problem Set 1

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Problem 1

Data: 1 yellow and 1 green M&M.
Want: The probability that the yellow M&M comes from the 1994 bag.

It is clear (based on the description of the problem) that the yellow M&M came from either the 1994 or the 1996 bag, so let's label our two hypotheses as follow:

H_1: the yellow M&M came from the 1994 bag.
H_2: the yellow M&M came from the 1996 bag.

Now we can write the Bayes' table for this problem.

Hypothesis	P(H)	P(D|H)	P(D|H) × P(H)	P(H|D)
H_1	0.5	$0.2 \times 0.2 = 0.04$	0.02	$0.02/0.027 = 0.74$
H_2	0.5	$0.14 \times 0.1 = 0.014$	0.007	$0.007/0.027 = 0.26$

- it is equally likely that the yellow M&M came from either the 1994 or the 1996 bag, so P(H) is 0.5 for both H_1 and and H_2.
- P(D|H_1) is the probability that the yellow M&M came from the 1994 bag (0.02) and, consequently, that the green M&M from the 1996 bag (0.02), hence $0.2 \times 0.2 = 0.04$.
- P(D|H_2) is the probability we the yellow M&M came from the 1996 bag (0.14) and, consequently, that the green M&M came from the 1994 bag (0.1), hence $0.14 \times 0.1 = 0.014$.
- the evidence, P(D), is the sum of the two values in the P(D|H) × P(H) column, 0.02+0.007=0.027.

So, from the probability table, we can read that the relative probability that the yellow M&M came from the 1994 bag is $\underline{0.02}$, while the normalized probability is $\underline{0.74 = 74\%}$.