

## Bayes' Rule and Testing For Independence

1) A rare disease affects 1 out of 1000 people. A blood test correctly detects the disease 99% of the time when the person actually has the disease, but incorrectly gives a positive result in 2% of the cases when the disease is not present.

a) Find the probability that a random person tests positive.

b) If the person does test positive, what is the probability that they actually have the disease?

c) What is the probability that the same person tests positive twice?

\*Assuming the test results are *independent*.

d) If the person tests positive twice, now what is the probability that the person actually has the disease?

2) You draw 2 cards from a deck of 52. Find the probability that the *1st* card was an ace given that the *2nd* card was an ace.

\*If  $A$  and  $B$  are independent events, then all of the following are true:

i)  $P(A/B) = \underline{\hspace{2cm}}$       ii)  $P(B/A) = \underline{\hspace{2cm}}$       iii)  $P(A \cap B) = \underline{\hspace{2cm}}$

---

3) Flip a coin twice. Let  $A$  = the event "1st flip is heads," and  $B$  = the event "2nd flip is heads." Are  $A$  and  $B$  independent events?

4) You are dealt one card from a deck of 52. Let  $A$  = the event that the card is a spade, and  $B$  = the event that the card is an ace. Are  $A$  and  $B$  independent events?

5a) A jar contains 4 red marbles and 6 green marbles. You pick two marbles randomly, one at a time, without replacement. Find the probability that the *2nd* marble is red.

b) Are the events “picking a red marble *1st*” and “picking a red marble *2nd*” independent?

6) A study by the National Lung Society found that of a group of 2,000 women, 680 were heavy smokers, 50 had emphysema, and 42 had both emphysema and were heavy smokers. Are the events “being a heavy smoker” and “having emphysema” independent?

\*7) A bag contains 8 fair coins and 2 unfair coins (heads on both sides). You randomly pick a coin, flip it, and it comes up heads. What is the probability that you picked a fair coin?