1. ("Base Rate Fallacy") Suppose a disease occurs in the population at a rate of 1%. A test for the disease has the following properties:
   - If a person has the disease, they will certainly test positive.
   - If a person does **not** have the disease, they will test negative 95% of the time and will test positive 5% of the time.

   Given that a person tests positive, what is the probability that they actually have the disease?

2. ("Deal or No Deal") Suppose you are on a game show with the following rules:
   There are 26 identical briefcases, each with a check for an amount of money inside; in 25 cases the check is for $1, but in the remaining case the check is for $1,000,000. You are allowed to choose one briefcase (but not open it yet). Then the host, who knows the location of the $1,000,000 check, opens 24 of the remaining 25 cases to reveal $1 checks. You then have the choice to switch your case with the remaining unopened case. You will open whichever one you choose to reveal your prize.
   Do you switch cases? Why or why not?
   Explain how this would be different if *you* had chosen which 24 cases to open instead of the host choosing (but they all still revealed $1 checks).

3. ("Berkson's Paradox") Suppose Alex will only date a man if he is handsome (H) or nice (N) (or both). Suppose that in general 10% of men are handsome and 30% are nice, and suppose that these traits are *independent*, in the sense that:
   $P[H|NX] = P[H|X] = 0.1$
   $P[N|HX] = P[N|X] = 0.3$

   Among the men Alex dates, what is the probability that any given one is nice? That is, what is $P[N|(H+N)X]$? [Hint: Consider the four mutually exclusive possibilities $HN,\ H\overline{N},\ \overline{H}N,\ \overline{H}\cdot\overline{N}$]

   Among the men Alex dates, given that one is handsome, what is the conditional probability that he is nice? That is, what is $P[N|H(H+N)X]$?
   Is this surprising? Can you think of other situations where this effect would show up?