Cold	Fever	Runny nose	P(C,F,R)
0	0	0	.48
0	0	1	.09
0	1	0	.024
0	1	1	.006
1	0	0	.008
1	0	1	.044
1	1	0	.048
1	1	1	.3

The table above shows the ***joint probability distribution*** of three binary variables that may conceivably be used to determine the likelihood a person has a cold.

Use the table above and your knowledge of probability to answer the questions

Q1 – What is the probability of a person having a cold, but no fever or runny nose?

P(cold=1, fever=0, rn=0) = 0.008

Q2 – What is the probability of a person not having a cold, but having fever and a runny nose?

P(cold=0, fever=1, rn=1) = 0.006

Q3 – What is p(Fever)? (i.e. The probability that Fever=1)

P(fever) = 0.024+0.006+0.048+0.3 = 0.378

Q4 – What is p(¬Fever)? (i.e. The probability that Fever=0)

P(not fever) = 1 - P(fever) = 0.622

Q5 – What is p(¬Fever, Cold)?

P(fever=0, cold=1) = 0.008+0.044 = 0.052

Q6 – What is p(¬Fever | Cold)?

P(not fever | cold)
= P(not fever, cold) / P(cold) = 0.052/(0.024+0.006+0.048+0.3) ~= 0.138

Q7 – Explain in words the difference between p(¬Fever, Cold) and p(¬Fever | Cold). Why are these values different?

Difference is that the first means the probability of two events happen at same time, second is the probability of the person doesn't have fever when he/she already has cold

Q8 – What is p(Fever | Cold, Runny nose)?

P((fever|cold) , rn) = P(fever,cold)/P(cold) * P(rn) = (0.048+0.3)/(0.008+0.044+0.048+0.3) * (0.09+0.006+0.044+0.3) = 0.3828

Q9 – In the absence of any measurements for F, R, and C. What is most likely:
A person has a fever
A person does not have a fever
Why? (i.e. justify in terms of the probability of 'some' event)

Since P(fever) = 0.378, so it's most likely a person doesn't have a fever

Q10 – Suppose you know R=1, what is more likely:
A person has a fever
A person does not have a fever
Why? (justify same as above)

Since
P(fever|R) = P(fever,R)/P(R) = (0.006+0.3)/(0.09+0.006+0.044+0.3) ~= 0.7
P(not fever|R) = P(not fever,R)/P(R) = (0.09+0.044)/(0.09+0.006+0.044+0.3) ~= 0.3
So a person is more likely have a fever when he/she already has runny nose

Q11 – Does knowing that a person has a runny nose change our belief about the probability the person has a fever?

If there is a relationship between having runny nose and fever, the if a persoan already have runny nose, then it's more likely to have a fever too.

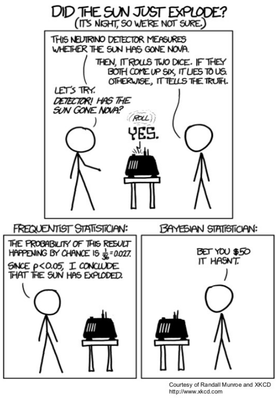
A quick reminder of Bayes Rule

$$p(x \mid y) = \frac{p(y \mid x)\, p(x)}{p(y)}$$

likelihood · prior · posterior · evidence

Q12 – Use Bayes Rule to compute p(Cold | Fever)

P(cold|fever) = P(fever|code)P(cold) / P(fever)
= (0.3+0.048)/(0.008+0.044+0.048+0.3)*(0.008+0.044+0.048+0.3)/(0.024+0.006+0.048+0.3)
~= 0.92



The 1-minute paper

You know the drill. Bring out an empty page and record your

Name (last, first) Zhang Jinming

Student number 1000997503

Explain the cartoon on the previous page! Should the man on the right have made a larger or smaller bet? Why?

The man on the right should bet all he has.
Because if the sun exploded, they all will be dead, if not, he get all the money.

Hand your 1-minute paper to your TA before you leave the tutorial room!