3/~~19~~/2019

25.11

~~24.7~~

(a): We are told that the test returns negative for 10% of sick students and 70% of healthy students; there are 100 students, 20 of which are sick and the remaining 80 are not. Then, 2 of the sick students return negative and 56 of the healthy students return negative: The probability of being a sick student given that the test result is negative is then:

$$\frac{2}{2+56} \cdot 100\% \approx 3.45\%$$

(b): We are going to multiply the initial ratios of good:Bad by the chances of these emitting sparks;

$$90\% : 10\% \cdot 4\% : 12\% \approx 3.6\% : 1.2\%$$

$$\approx 36 : 12$$

Now that we have calculated the ratio of good:Bad widgets that spark, find the probability of getting a bad widget:

$$\frac{12}{36+12} = \frac{12}{48} = 25\%$$

(c): The probability form returns the percent chance of the outcome in question occuring, while the odds form returns a ~~ratio~~ ratio of the composition of the overlapping outcomes. We add the value of the numerator to the denominator, ~~for ex~~ to find the probability; given the ratio, ~~the pr~~

$$\left(\frac{Z}{K}\right)$$

the probability can be written as

$$\frac{Z}{K+Z}$$

Now we'd like to prove Bayes's rule, that

$$\frac{P(H_j)}{P(H_k)} \cdot \frac{P(e_0 \mid H_j)}{P(e_0 \mid H_k)} = \frac{P(H_j \mid e_0)}{P(H_k \mid e_0)}$$

We see by the definition of conditional probability that $P(X \wedge Y) = P(Y) \cdot P(X \mid Y)$, thus

$$\ldots = \frac{P(e_0 \wedge H_j)}{P(e_0 \wedge H_k)}$$ where $\wedge$ is the intersection of the prob.

multiply this by $\frac{1}{e_0} / \frac{1}{e_0}$ and note that intersection is commutative

$$\ldots = \frac{P(e_0 \mid H_j)/e_0}{} = \frac{P(H_j \wedge e_0)}{P(H_k \wedge e_0)} \cdot \frac{1/e_0}{1/e_0} = \frac{P(H_j \wedge e_0)/e_0}{P(H_k \wedge e_0)/e_0}$$

Recall that $P(X \wedge Y) / P(Y) = P(X \mid Y)$

$$\ldots = \frac{P(H_j \mid e_0)}{P(H_k \mid e_0)}$$

(d): Each drawer has a 10% probability mass;

8 drawers · 10% mass drawer^{-1} + 20% dresser = 100%.

Since we have searched 6 drawers without finding the socks, then

2 · 10% + 20% not in dresser = 40%.

The chance of finding the socks in the next drawer is 1/4th of their remaining probability mass

$\frac{10\%}{40\%} \cdot 100\% = 25\%$.

(e): Refer to GitHub.

(f): Consider "Young Earth creationism." Followers of this idea suppose the earth was created by a god less than 10k years ago; "ordinary" evidence such as carbon dating, fossils, and evolution serve to ~~overwhelmingly~~ find this idea highly improbable. However, proponents request/demand 100% confident world-shaking proofs such as the existence or non-existence of a god.

(g): Bayesian surprise is defined intuitively as a measure of how surprising a result is, in units of "nats" or "bits", corresponding mathematically to given a hypotheses

$S_b = -\log_2(P(e|H))$

$S_n = -\ln(P(e|H))$

~~1 bit represents~~

The given statement ~~represents~~, ~~which~~ describes that for a certain piece of evidence, it had a 1/2 chance of occurring by that hypotheses. To have one nat of evidence suggests that $P(e|H) = e^{-1}$.

(h): A good scientific theory has the qualities of being "bold", precise, and replicable. We consider quantum mechanics as a whole. First we consider the unexpected things that quantum mechanics wants to, and does, explain.

Consider the photo electric effect: quantum mechanics assumes a photon to be a packet of EM energy/radiation with $e = hv$; If the energy of a single photon matches or is greater than the bonding energy of the electron, its energy state increase or it is released. Under classical mechanics, any light in high enough quantity could cause ionization, which is observably false.

Then consider the precision; Classical mechanics tells us that electrons orbit around a nucleus, but quantum mech. tells us about orbitals and valence electron energies and so on; giving accurate

and usable information.

Finally, with the right humans, the concepts of quantum mechanics are infinitely replicable. A tool that measures spin is always going to get a 1:1 split of up: down electrons, assuming they were inputted unsorted.