APPLIED BAYERSIAN STATISTICS

EXPERIMENT SHOWING SUCESSIVE REALLOCATION OF CREDIBILITY

DETERMINING THE PROBABILITY OF HAVING A FLU

SECTION 1

The situation is that, a person is finished lunch at his work place and suddenly feels horrible. So, he lies down on his desk and within a few minutes he begins to panic and fears that he may have a Flu. He immediately remembers that his colleague was also sick, and he fears that he might have to cancel the trip, that he had planned for next week because of this.

The main question/hypothesis that arises in the mind of the person is that:

“Do I have a FLU?”

CREDIBILITY 1: He has a headache and a sour throat. It is believed that people with the same symptoms might have a Flu, as it has similar symptoms 90% of the time.

CREDIBILITY 2: He then grabs his phone, searches google.com and finds that 5% of the population will get Flu in this year. So, the probability of the person having the Flu is 5% now.

CREDIBILITY 3: He then finds one article on the newspaper that says that 20% of the population will have a headache and sore throat in this year.

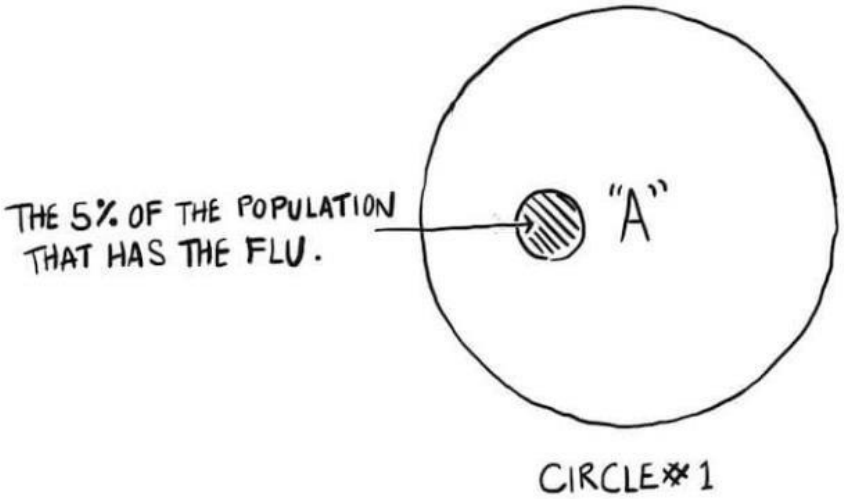
In these types of cases, we use Bayer’s statistical analysis can be used to solve the problem as we can update a hypothesis on new upcoming evidences.

INFERENCES FROM THE HYPOTHESIS:

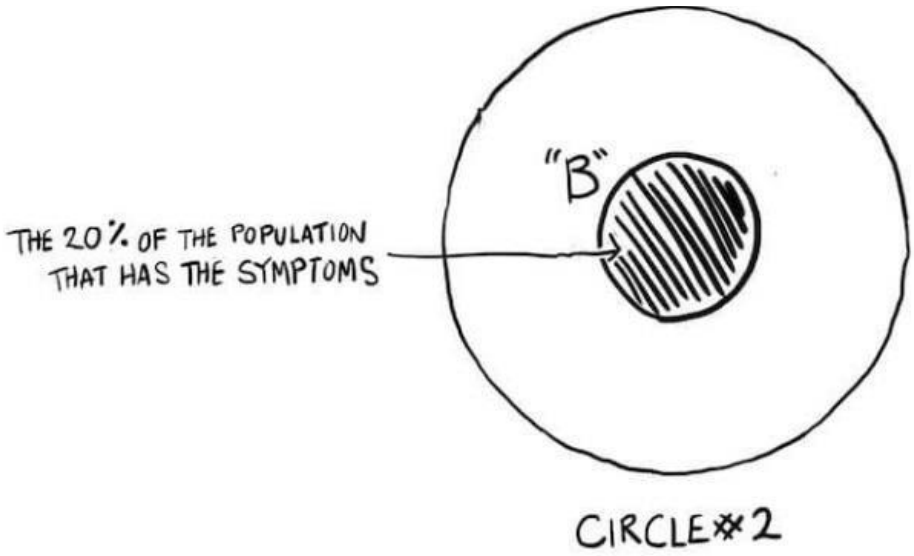
- People will have a headache and sour throat if they have a Flu 90% of the time.
- In general, the probability of having a Flu is 5%.
- 20% of the population will have a headache and sour throat this year.

We need to find the probability of having a Flu given our current symptoms.

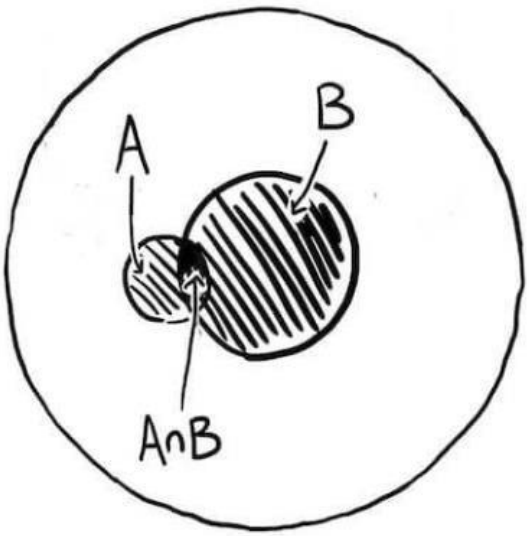
We visualize the problem using Bayer’s theorem to have better understanding and picturization.



In the above diagram, the circle represents the entire population and the shaded region represents the 5% of population that has Flu. The possible outcomes are either the people can have Flu or not have Flu. The probability of A is P(A) = 5%.



The above depicts all the people who have who have and don't have symptoms. The shaded region B represents 20% of the population who have symptoms. The probability of B is P(B) = 20%.



In this diagram both the previous circles are merged. It can be concluded that:

- The blank/white area inside the big circle represents the people who do not have either Flu or the 2 symptoms.
- Circle A has a shaded area which shows the people who have Flu.
- Circle A has a shaded area which shows the people who have symptoms.

The intersection point of shaded circle A and shaded circle B is the probability of P(A|B), of having the Flu given our symptoms.

We will make use of Bayer's theorem in a mathematical way:

Step 1: We have picturized the problem in Bayer's theorem using a Venn diagram, now we will be calculating the probability of having a Flu, given its symptoms.

Step 2: Plugging the values in the formula:

$$P(A|B) = \frac{P(B|A) * P(A)}{P(B)} \qquad P(FLU|SYMPTOMS) = \frac{P(SYMPTOMS|FLU) * P(FLU)}{P(SYMPTOMS)}$$

Step 3: Substitute the values

- P(A) is P(FLU) = 0.05 or 5%
- P(B|A) is P(SYMPTOMS|FLU) = 0.9 or 90%
- P(B) is P(SYMPTOMS) = 0.2 or 20% **Step 4:** Calculate the formula:

P(A|B) or P(FLU|SYMPTOMS) = (0.9*0.5)/0.2

= 0.225 or **22.5%**

CONCLUSION

We conclude from the above analysis that if the person is having a sore throat and a headache, then there is 22.5% chance that the person is having a Flu.

The difference between the classical statistical analysis and Bayesian statistical analysis is that it helps us to update the hypothesis on new evidence. Previously, we thought that the probability of having the Flu was 90%. The result is more accurate.

REFERENCES

Bayes' Theorem. (2018). Learn Bayes' Theorem with Visual Examples + Solutions. [online] Available at: https://www.bayestheorem.net/ [Accessed 10 Aug. 2018].