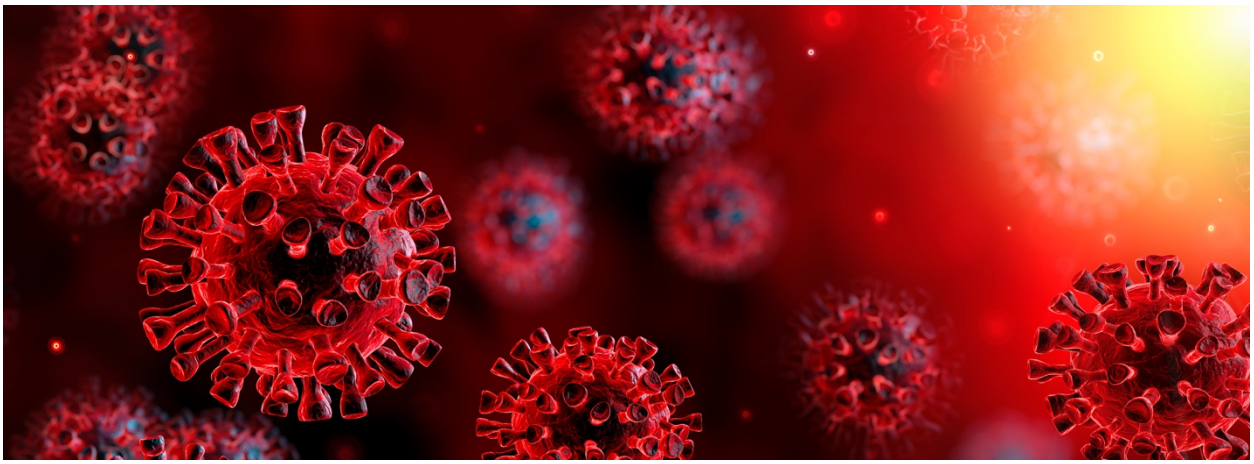
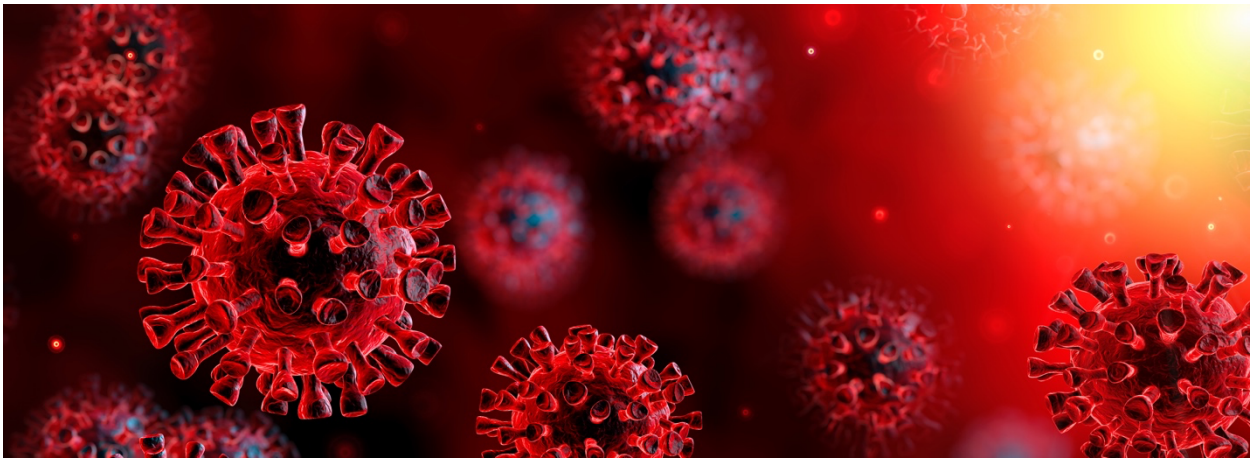
Conditional Probabilities



What is the Probability of an event given a particular condition? This is explored as a conditional probability when we want to compute the likelihood of events given particular conditions.

The Corona Virus (COVID-19) is a serious matter that is not to be taken lightly. I will be using **fictitious** data to illustrate how the conditional probability definition is used in the Health Industry. This is relevant to all our lives today. This process can be applied to any medical testing we all face and is very interesting.



The following data is a **fictitious** sample of 500 people who were tested for COVID-19.

Covid-19	Test +	Test -	Total
Infected	15	18	33
Not Infected	105	362	467
Total	120	380	500

Using our definition of probability, we can answer some fundamental questions using data from this table. If you select a person at random, what's the probability the person:

1. Is infected ?
2. Is not-infected ?
3. Tests + ?
4. Tests - ?

What is not mentioned to students is that people were actually tested twice to find the errors associated with this particular blood testing procedure. In fact, all medical testing procedures have built in "errors" unique to the test. The errors can be significant or insignificant. In order to compute the "errors" we will need to consider the table and the conditional probability formula.

Def- Probability of A given that B

$$P(A|B) = \frac{n(A \text{ and } B)}{n(B)}$$

B is the condition.

This is known or has happened.

If you select a person at random, what's the probability the person:

5. Test - **given that** the person infected ?

$$P(test - |infected) = \frac{n(test - \ and \ infected)}{n(infected)}$$

Def- False Negative
A test result that incorrectly indicates a person does not have a particular condition.

6. Test + **given that** the person not infected?

$$P(test + |not \ infected) = \frac{n(test + \ and \ not \ infected)}{n(not \ infecteed)}$$

Def- False Positive
A test result that incorrectly indicates a person has a particular condition.

Similarly, we have what is known as true positives and true negatives.

7. Tests + **given that** the person is infected?

$$P(test + \ | \ infected \ ) = \frac{n(test + and \ infected \ )}{n(\ infected \ )}$$

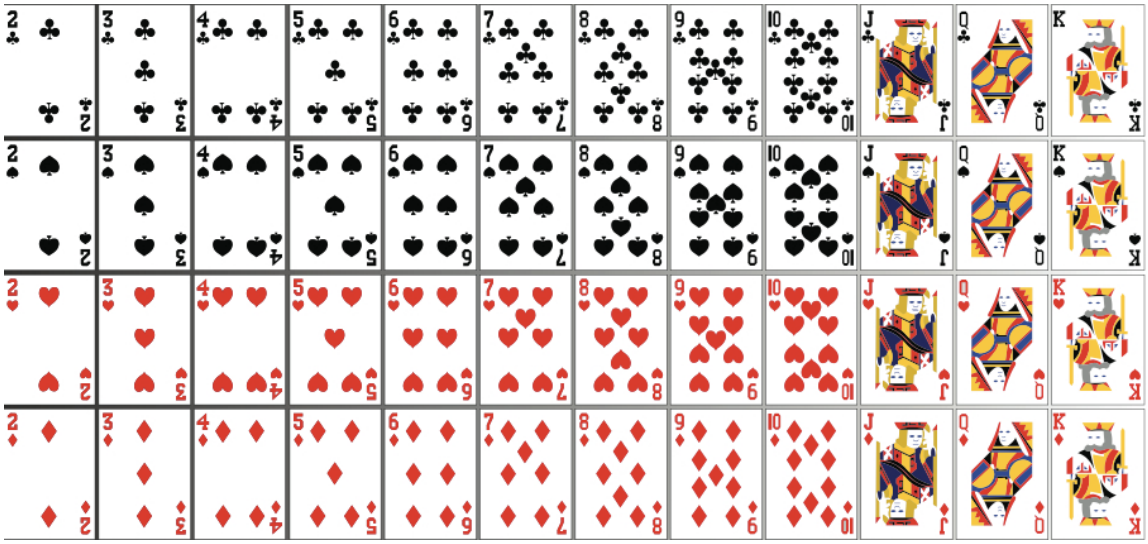
Def- True Positive
A positive test result that correctly indicates a condition is present.

8. Tests - **given that** the person is not infected?

$$P(test - \ | \ not \ \ infected \ ) = \frac{n(test - and \ not \ infected \ )}{n(not \ \ infected \ )}$$

Def- True Negative
A negative test result that correctly indicates that a condition is not present.

We can use the same definitions to answer probability questions for another experiment. Consider a Standard Deck of Cards with the Ace is High.



If you select a card at random, what's the probability the cards is:

9. An Ace **given that** the card is Red?

10. Red **given that** the card is an Ace?

11. Heart **given that** the card is Red?

12. Heart **given that** the card is Black?

13. Spade **given that** the card is Black?

14. Black **given that** the card is a Spade?

15. Queen **given that** you draw a face card?

16. Face Card **given that** the card is a Diamond?