Confident

# Wights in Winterfell

Population 1000

400 infected (positive)

false positive rate of 5%

false negative rate 0%

## Confusion Matrix

|  |  |  |  |
| --- | --- | --- | --- |
|  | Total Population | Test positive | Test negative |
| Infected | 400 | 400 | 0 |
| Not infected | 600 | 30 | 570 |

If I test positive, I am either one of 400 infected, or 30 not infected. The tests positive predictive value is thus 400 / 430 = 0.93. So if I am tested positive, it is 93% sure that I am in fact infected.

# Wights in Riverrun

Population 1000

20 infected (positive)

false positive rate of 5%

false negative rate 0%

## Confusion Matrix

|  |  |  |  |
| --- | --- | --- | --- |
|  | Total Population | Test positive | Test negative |
| Infected | 20 | 20 | 0 |
| Not infected | 980 | 49 | 931 |

If I test positive, I am either one of 20 infected, or 49 not infected. The tests positive predictive value is thus 20 / 69 = 0.29. So if I am tested positive, it is only 29% sure that I am in fact infected.

# Walkers in Westeros

Population 1’000’000

1 infected (positive)

false positive rate of 1%

false negative rate 1%

## Confusion Matrix

|  |  |  |  |
| --- | --- | --- | --- |
|  | Total Population | Test positive | Test negative |
| Infected | 1 | 0.99 | 0.01 |
| Not infected | 999’999 | 9999.99 | 989999.01 |

If I test positive, I am either the one infected, or one of the 9999.99 not infected. The tests positive predictive value is thus 1 / (9999.99 + 0.99) = 0.000099. So if I am tested positive, it is less than one hundredth of a percent sure that I am in fact infected.

This makes me not very happy with the test for most scenarios.

Rule

Notation

Bayes Theorem:

P(A|B) = P(B|A) \* P(A) / P(B)

P(positive) = P(positive|cancer) \* P(cancer) + P(positive|not cancer) \* P(not cancer)

= 0.98 \* 0.008 + 0.03 \* 99.2 = 0.038

P(negative) = 1 - P(positive) = 0.9624

P(cancer|positive) = P(positive|cancer) \* P(cancer) / P(positive)

= 0.98 \* 0.008 / 0.038 = 0.206

P(not cancer|positive) = 1 – P(cancer|positive) = 0.793

P(not cancer|negative) = P(negative|not cancer) \* P(not cancer) / P(negative)

= 0.97 \* 0.992 / 0.9624 = 0.999

P(cancer|negative) = 1 – P(not cancer|negative) = 0.0002

|  |  |
| --- | --- |
|  |  |
| P(cancer) = 0.008 | We know that 0.8% of people have cancer |
| P(not cancer) = 0.992 | We know that 99.2% of people do not have cancer |
| P(cancer|positive) = 0.206 | If the test returns positive, there is a 20% chance that that the patient has cancer |
| P(cancer|negative) = 0.0002 | If the test returns negative, there is a 0.01% chance the patient has cancer |
| P(not cancer|positive) = 0.793 | If the test returns positive, there is a 79% chance the patient does not have cancer |
| P(not cancer|negative) = 0.999 | If the test returns negative, there is a 99.9% chance the patient does not have cancer |
| P(positive|cancer) = 0.98 | If cancer is present, the test returns a correct positive result 98% of the time. |
| P(negative|cancer) = 0.02 | If cancer is present, the test returns an incorrect negative result 2% of the time |
| P(positive|not cancer) = 0.03 | It returns an incorrect positive result 3% of the time if the cancer is not present |
| P(negative|not cancer) = 0.97 | It returns a correct negative result 97% of the time if the cancer is not present. |