Conditional Probability – MedicalTesting

# False Positives and False Negatives; True Positives and True Negatives

 Unfortunately, people develop inflictions with various viruses and develop illnesses. We often seek to test individuals for those inflictions and illnesses. We also test individuals for various other medical conditions or for possible drug use. Every test has a certain degree of accuracy that we should be made aware of and consider. Tests have various error rates that are defined below to help us understand aspects of testing that we should be aware.

**Def False Positive (FPR)**

The likelihood of incorrectly testing + for an infliction when you actually are not infected.

$$P\left(test+\left|not Infected\right.\right)$$

**Def False Negative (FNR)**

The likelihood of incorrectly Testing – for an infliction when you are actually infected.

$$P\left(test-\left|nfected\right.\right)$$

**Def True Negative (TNR)**

The likelihood of correctly testing – when you really are not infected.

$$P\left(test-\left|not infected\right.\right)$$

**Def True Positive (TPR)**

The likelihood of correctly testing + when you are really infected.

$$P\left(test+\left|infected\right.\right)$$

**Def Prevalence**

The likelihood that a person has an illness or infliction.

$$P\left(infected\right)$$

# False- Positive HIV Tests Results

The following table is based on information from the CDC for people who engage in “at risk” behavior and have a higher prevalence rate.

<https://www.cdc.gov/hiv/pdf/testing/cdc-hiv-factsheet-false-positive-test-results.pdf>

|  | **Has HIV Virus** | **Not Have HIV Virus** | Total |
| --- | --- | --- | --- |
| Test + | 180 | 40 | 220 |
| Test - | 20 | 9760 | 9780 |
| Total | 200 | 9800 | 10000 |

Compute the following rates by selecting a person at random from this table.

1. False Positive Rate.
2. False Negative Rate.
3. True Positive Rate.
4. True Negative Rate.

# Breast Cancer in Women

<https://brownmath.com/stat/falsepos.htm>

The following information was obtained from a study on the effectiveness of Core-Needle and Open Surgical biopsy for the diagnosis of Breast Lesions.

|  | **Have Breast Cancer** | **Doesn't Have Breast Cancer** | Total |
| --- | --- | --- | --- |
| **Test +** | 25800 | 1400 | 27200 |
| **Test -** | 4200 | 68600 | 72800 |
| Total | 30000 | 70000 | 100000 |

Compute the following rates by selecting a person at random from this table.

1. False Positive Rate.
2. False Negative Rate.
3. True Positive Rate.
4. True Negative Rate.

# SARS-CoV-2 IgG antibody tests for COVID-19

The concepts of Sensitivity and Specificity for testing for Covid-19 vary by type of tests that are used. There are various types of tests that have particular benefits and drawbacks. You can read about some of them from information posted by ARUP Laboratories.

<https://www.aruplab.com/news/4-21-2020/How-Accurate-Are-COVID-19-Tests>

The following table summarized information found from ARUP Laboratories and represents a information about a test that detects IgG antibodies specific to the S1 domain of the spike protein of SARS-CoV-2.

<https://www.aruplab.com/infectious-disease/coronavirus/testing>

# Performance of IgG antibody test

|  | **Infected** | **not Infected** | **Total** |
| --- | --- | --- | --- |
| test + | 88 | 4 | 92 |
| test - | 0 | 1066 | 1066 |
| Total | 88 | 1070 | 1158 |

Compute the following rates by selecting a person at random from this table.

1. False Positive Rate.
2. False Negative Rate.
3. True Positive Rate.
4. True Negative Rate.

The following table summarized information found from ARUP Laboratories and represents a information about a test that detects IgG antibodies specific to the nucleocapsid protein of SARS-CoV-2.

<https://www.aruplab.com/infectious-disease/coronavirus/testing>

|  | **Infected** | **not Infected** | **Total** |
| --- | --- | --- | --- |
| test + | 27 | 0 | 27 |
| test - | 3 | 80 | 83 |
| Total | 30 | 80 | 110 |

Compute the following rates by selecting a person at random from this table.

1. False Positive Rate.
2. False Negative Rate.
3. True Positive Rate.
4. True Negative Rate.