

# Types of errors

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#### **Basic terms**

In general, **Positive** = identified and **negative** = rejected. Therefore:

**True positive** = correctly identified

False positive = incorrectly identified

**True negative** = correctly rejected

False negative = incorrectly rejected

Medical testing example:

**True positive** = Sick people correctly diagnosed as sick

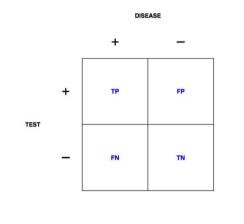
False positive= Healthy people incorrectly identified as sick

**True negative** = Healthy people correctly identified as healthy

**False negative** = Sick people incorrectly identified as healthy.

http://en.wikipedia.org/wiki/Sensitivity\_and\_specificity

## **Key quantities**



Sensitivity  $\rightarrow$  Pr ( positive test | disease )

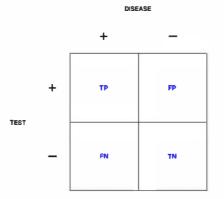
Positive Predictive Value  $\rightarrow$  Pr ( disease | positive test )

Negative Predictive Value → Pr ( no disease | negative test )

Accuracy  $\rightarrow$  Pr ( correct outcome )

http://en.wikipedia.org/wiki/Sensitivity\_and\_specificity

### **Key quantities as fractions**



```
Sensitivity \rightarrow TP / (TP+FN)

Specificity \rightarrow TN / (FP+TN)

Positive Predictive Value \rightarrow TP / (TP+FP)

Negative Predictive Value \rightarrow TN / (FN+TN)

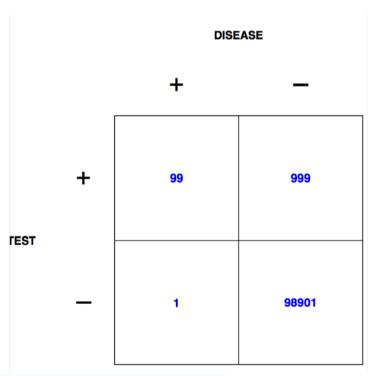
Accuracy \rightarrow (TP+TN) / (TP+FP+FN+TN)
```

### **Screening tests**

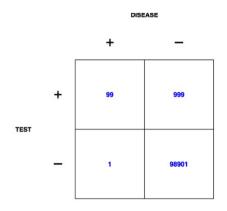
Assume that some disease has a 0.1% prevalence in the population. Assume we have a test kit for that disease that works with 99% sensitivity and 99% specificity. What is the probability of a person having the disease given the test result is positive, if we randomly select a subject from

- the general population?
- a high risk sub-population with 10% disease prevalence?

# **General population**



#### General population as fractions



```
      Sensitivity
      \rightarrow 99 / (99+1) = 99%

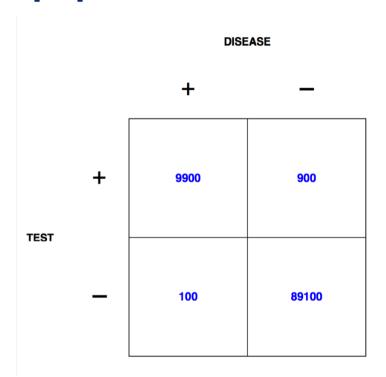
      Specificity
      \rightarrow 98901 / (999+98901) = 99%

      Positive Predictive Value
      \rightarrow 99 / (99+999) \approx 9%

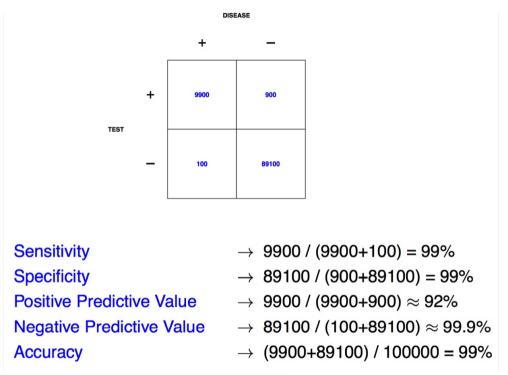
      Negative Predictive Value
      \rightarrow 98901 / (1+98901) > 99.9%

      Accuracy
      \rightarrow (99+98901) / 100000 = 99%
```

# At risk subpopulation



#### At risk subpopulation as fraction



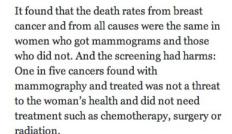
#### Key public health issue

#### Vast Study Casts Doubts on Value of Mammograms

By GINA KOLATA FEB. 11, 2014



One of the largest and most meticulous studies of mammography ever done, involving 90,000 women and lasting a quarter-century, has added powerful new doubts about the value of the screening test for women of any age.



The study, published Tuesday in The British Medical Journal, is one of the few rigorous



Nearly 75 percent of American women 40 and over say they had a mammogram in the past year. Damian Dovarganes/Associated Press

### Key public health issue



#### For continuous data

Mean squared error (MSE):

$$\frac{1}{n} \sum_{i=1}^{n} (Prediction_i - Truth_i)^2$$

Root mean squared error (RMSE):

$$\frac{1}{n} \sum_{i=1}^{n} (Prediction_i - Truth_i)^2$$

#### **Common error measures**

- 1. Mean squared error (or root mean squared error)
  - · Continuous data, sensitive to outliers
- 2. Median absolute deviation
  - · Continuous data, often more robust
- 3. Sensitivity (recall)
  - · If you want few missed positives
- 4. Specificity
  - · If you want few negatives called positives
- 5. Accuracy
  - · Weights false positives/negatives equally
- 6. Concordance
  - · One example is kappa