



Test measurements

Computer Skills 100/ Medical

Tahani Khatib

CIS/ KASIT

The University of Jordan

Sick or healthy?



Ask your Doctor

Positive or Negative?

positive diagnosis →
sickness

Negative diagnosis →
Healthiness



False or True?

Wrong diagnosis →
False

True diagnosis →
True



True Positive (TP)



You are
SICK!



False Negative (FN)



You are
healthy!



True Negative (TN)



You are healthy!

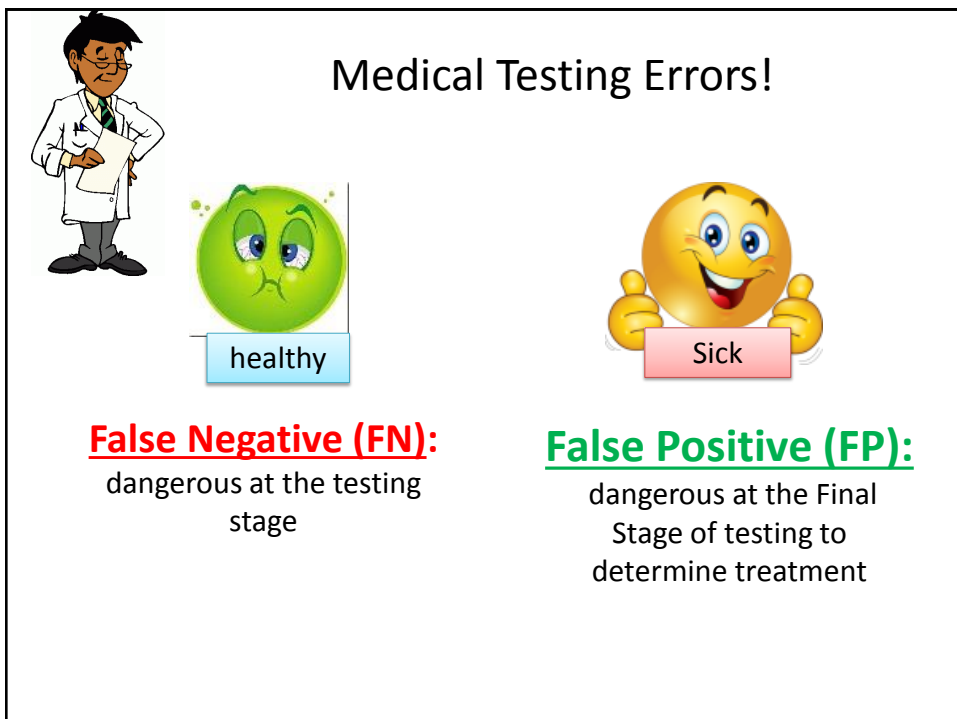
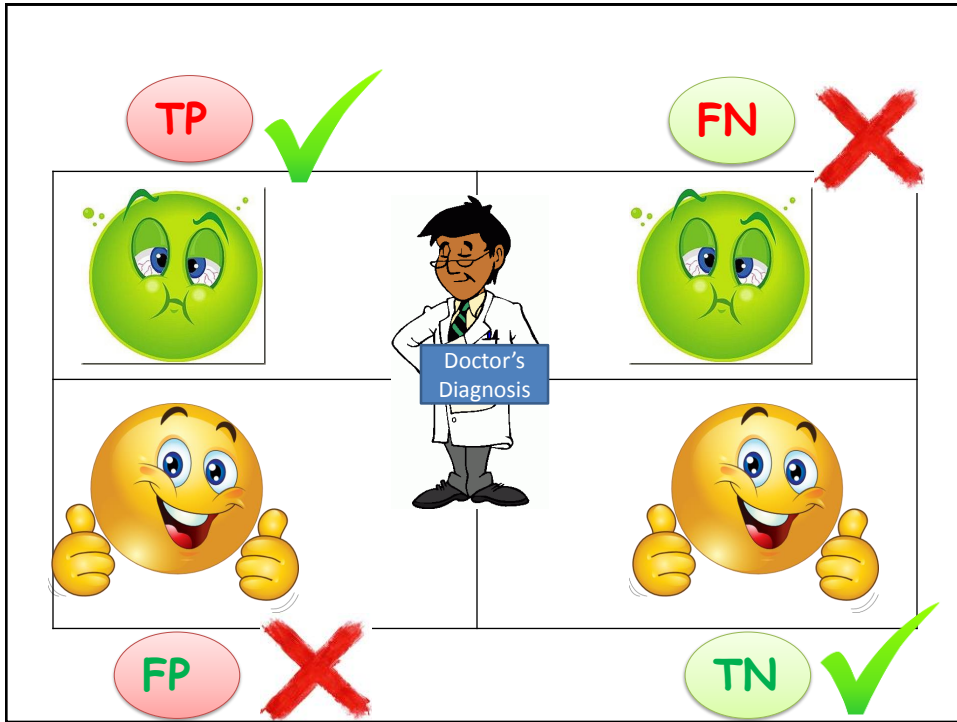


False positive (FP)



You are SICK!



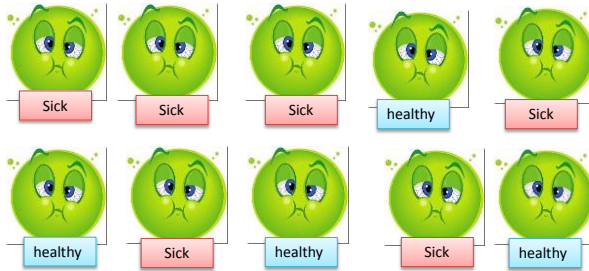


Sensitivity

A measure of the test ability to measure positive cases.

The percentage of sick people who are correctly identified as having the condition .

$$\text{Sensitivity} = \frac{TP}{TP + FN}$$



TP=6
FN=4

Sensitivity = 6/10 = 0.6



Specificity

A measure of the test ability to measure negative cases.

$$\text{Specificity} = \frac{TN}{TN + FP}$$



TN=8
FP=2

Specificity = 8/10 = 0.8



Positive Predictive Value (PPV)

The proportion of positive test results that are true positives.

Also known as Precision Rate

$$PPV = \frac{TP}{TP + FP}$$



TP=6



FP=2



TN=8



FN=4

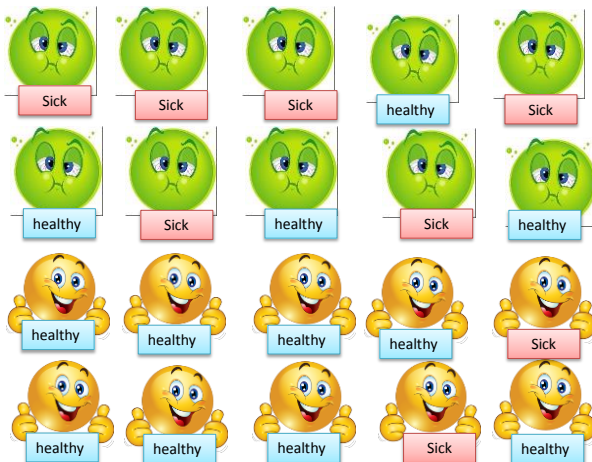


PPV= 6/8

Negative Predictive Value (NPV)

The proportion of negative test results that are true negatives.

$$NPV = \frac{TN}{TN + FN}$$



TP=6



FP=2



TN=8



FN=4




NPV= 8/12


Diagnostic Accuracy (effectiveness)


- The proportion of the **success rate** of a given test.


$$Accuracy = \frac{TP + TN}{TP + TN + FP + FN}$$



TP=6 

FP=2 

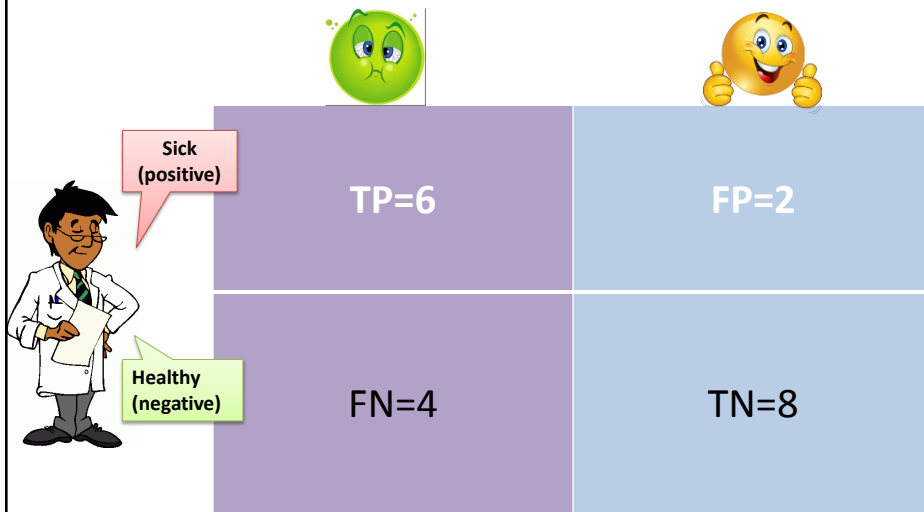
TN=8 

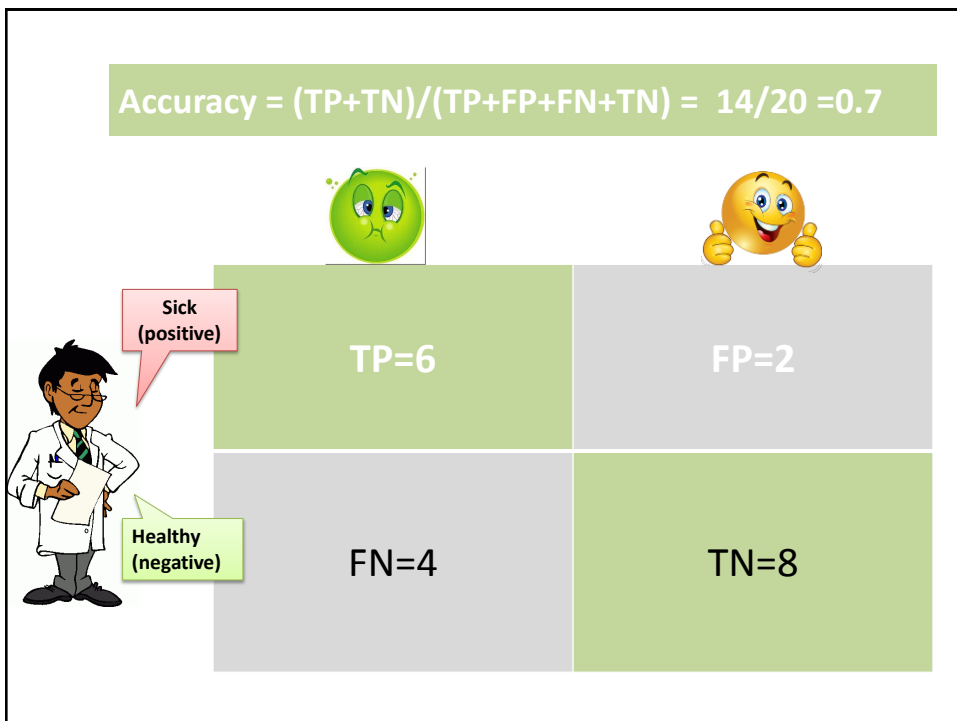
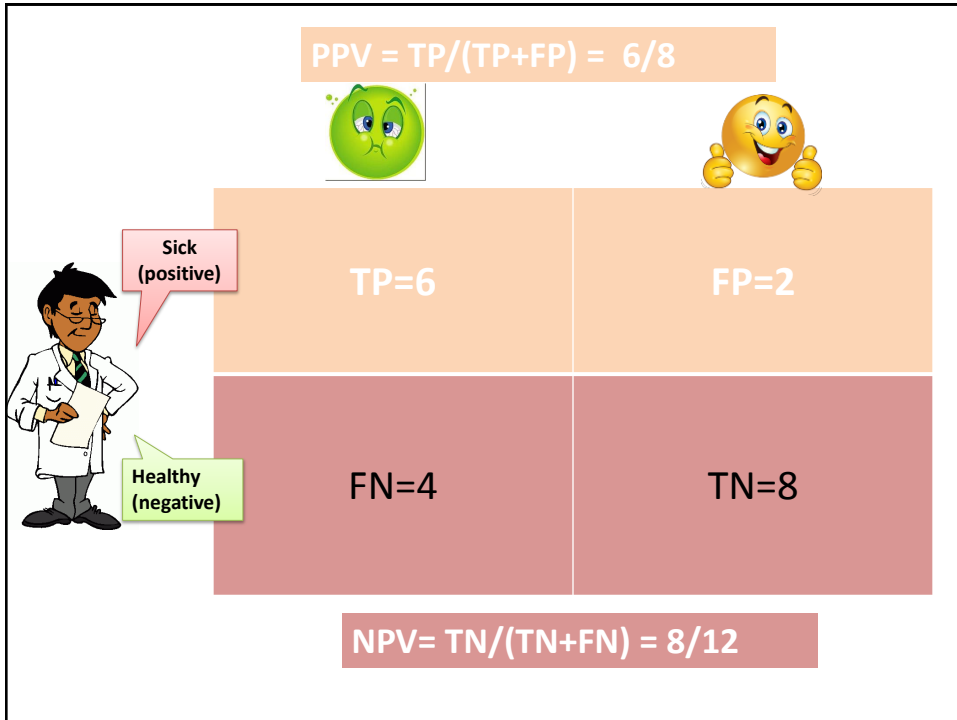
FN=4 

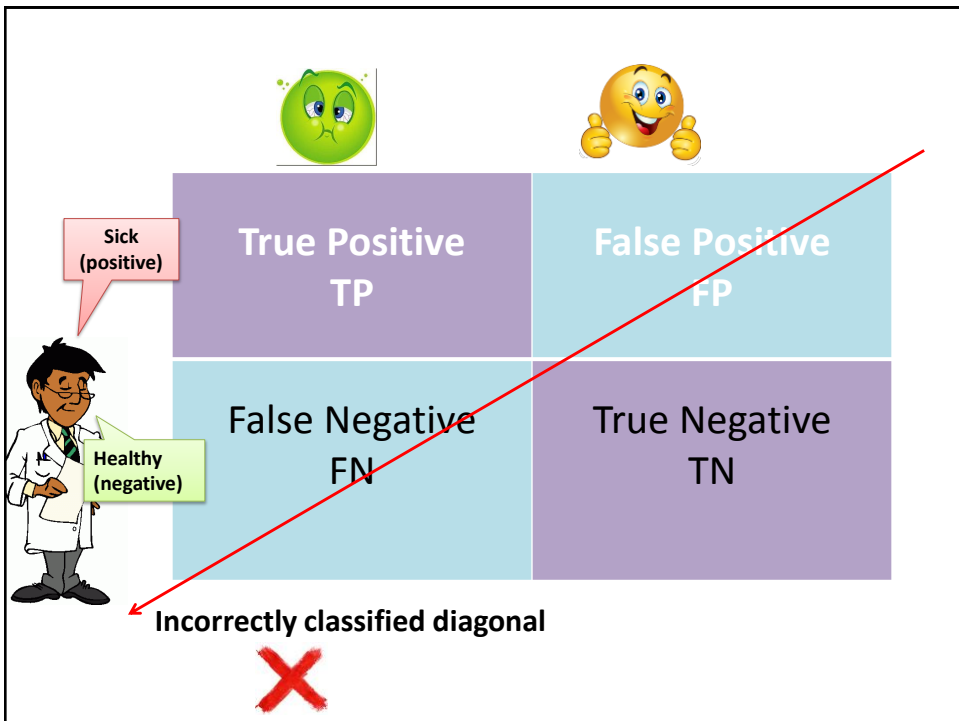
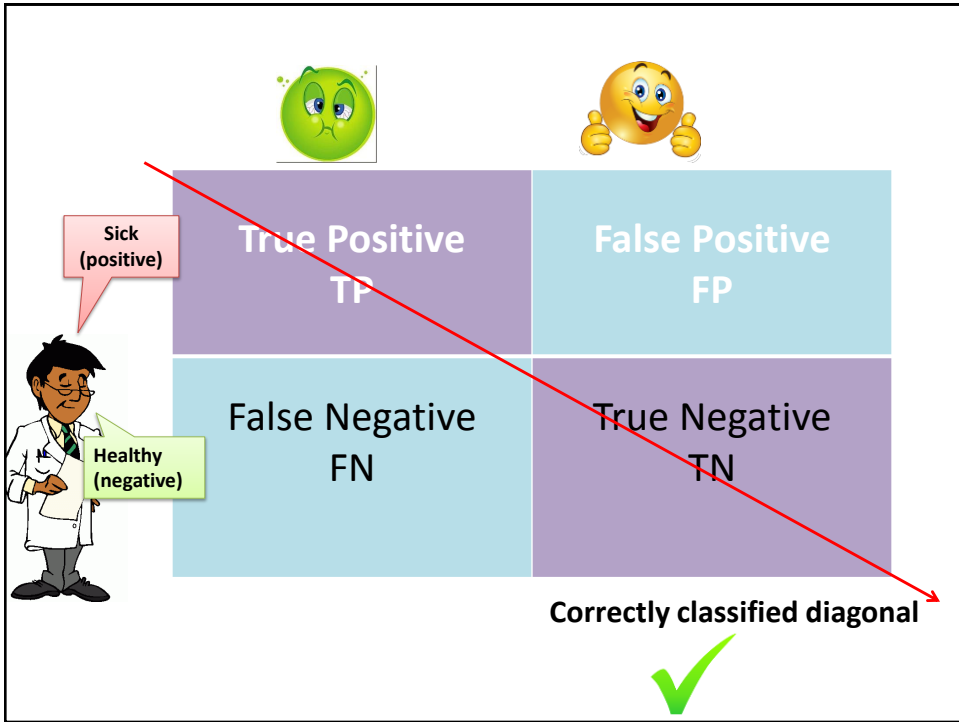
Accuracy = 14/20
= 0.7

Sensitivity =
 $TP / (TP + FN) = 0.6$

specificity =
 $TN / (FP + TN) = 0.8$

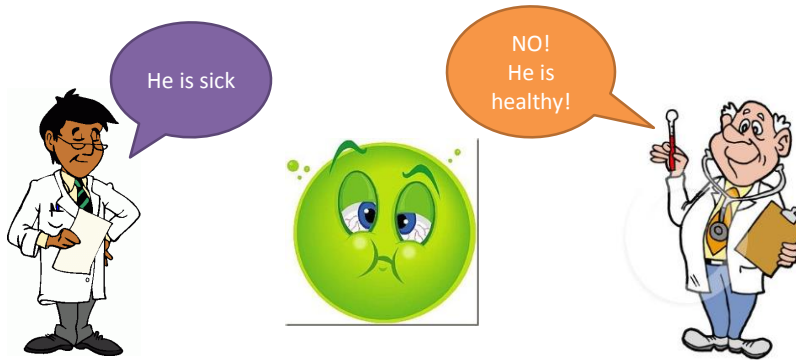






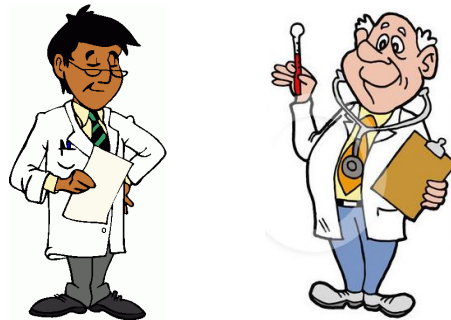
Inter-rater reliability (Agreement)

A Measure of the degree of agreement (homogeneity) between judges (raters, observers) for rating a given task.



Kohen's Kappa

- Kappa is a statistical measure of agreement in ratings between two raters.



Sick or Not?



Sick or Not?

Doctor 1



Doctor 2



Agreement?

Patient ID	doctor1	doctor2
P1	YES	NO
P2	NO	YES
P3	NO	NO
P4	NO	NO
P5	YES	YES
P6	YES	YES
P7	NO	NO
P8	NO	NO
P9	YES	YES
P10	YES	NO

Doctors Opinions		Doctor 2	
		YES	NO
Doctor 1	YES	3	2
	NO	1	4

Agreement?

Use Cappa to test! →

$$k = \frac{\Pr(a) - \Pr(e)}{1 - \Pr(e)}$$

Let's do our calculations now ☺

suppose that:

Doctors Opinions		Doctor 2	
		YES	NO
Doctor 1	YES	3	2
	NO	1	4

a = Agreements on (yes)

b = Agreements on (NO)

n = total number of patients

Pr(a): observed agreement among coders (doctors)

$pr(a) = (a+b) / n$

So in our example:

a=3

b=4

n=10

then

$pr(a) = (a+b) / n$

$= (3+4) / 10$

$pr(a) = 0.7$



Agreement?

Use Cappa to test! →

$$k = \frac{\Pr(a) - \Pr(e)}{1 - \Pr(e)}$$

Now :

$\Pr(e)$: is the probability of random agreement.

Doctors Opinions		Doctor 2 	
		YES	NO
Doctor 1 	YES	3	2
	NO	1	4

$\Pr(e) =$

$$\Pr(\text{yes doctor 1}) * \Pr(\text{yes doctor 2}) + \Pr(\text{No doctor 1}) * \Pr(\text{No doctor 2}).$$

So in our example:

$$\Pr(\text{yes doctor 1}) = 5/10$$

$$\Pr(\text{yes doctor 2}) = 4/10$$

$$\Pr(\text{No doctor 1}) = 5/10$$

$$\Pr(\text{No doctor 2}) = 6/10$$

$$\Pr(e) = 0.5 * 0.4 + 0.5 * 0.6$$

$$\Pr(e) = 0.5$$

Agreement?

Use Cappa to test! →

$$k = \frac{\Pr(a) - \Pr(e)}{1 - \Pr(e)}$$

Ok .. Now we have all we need to calculate

kappa! 👍 😊

$$\Pr(a) = 0.7$$



$$\Pr(e) = 0.5$$

$$k = \frac{\Pr(a) - \Pr(e)}{1 - \Pr(e)}$$

$$K = (0.7 - 0.5) / (1 - 0.5)$$

$$= 0.2 / 0.5 = 0.4$$

$$K = 0.4$$

Doctors Opinions		Doctor 2 	
		YES	NO
Doctor 1 	YES	3	2
	NO	1	4

Agreement according to Kappa?



According to the table of kappa statistical interpretation, our agreement is fair!

$K = 0.4$?
What does that mean?
do we strongly agree or not?



Kappa Statistics Interpretation

Kappa Scale

Chance Agreement	Poor	Slight	Fair	Moderate	Substantial	Almost Perfect
< 0.0	0.0	.20	.40	.60	.80	1.0

Now it's your turn!

- Suppose that there were 200 patients in the hospital, and the cases agreement table between two doctors was as follows, apply kappa test to find and interpret the Measure of the degree of agreement between the two doctors. (use Excel if you wish)



Doctors Opinions		Doctor 2	
		YES	NO
Doctor 1	YES	70	40
	NO	30	60

