

## Discrimination & Evaluation

### In this lecture

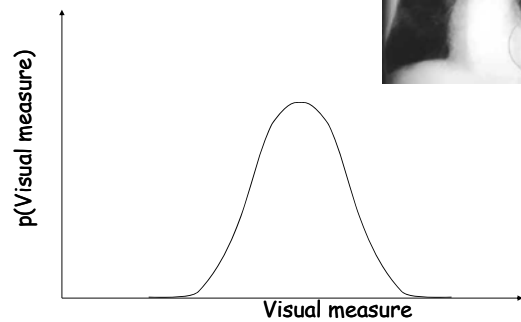
- Discrimination
- Discrimination index
- Sensitivity & Specificity
- ROC curves

### Evaluation

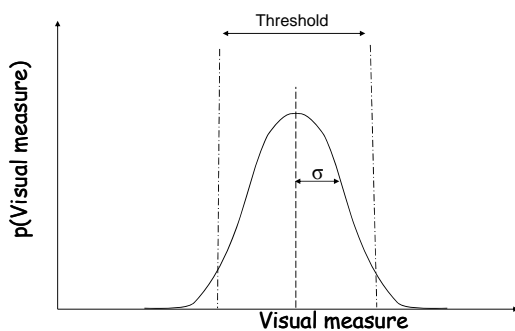
Assessing whether enhancement improves the systems ability to differentiate between cases in different categories

- Diagnosis:
  - differentiate sick and healthy patients

### Visual Measure



### Visual Measure



### Discrimination of Binary Outcomes

Diseased



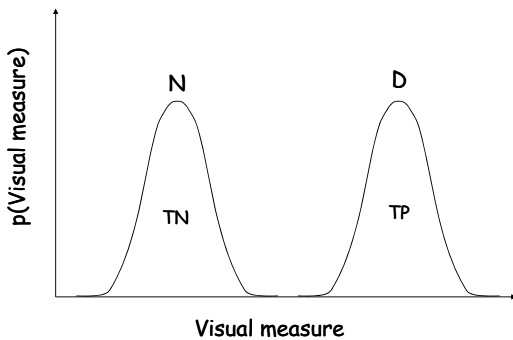
Disease Absent



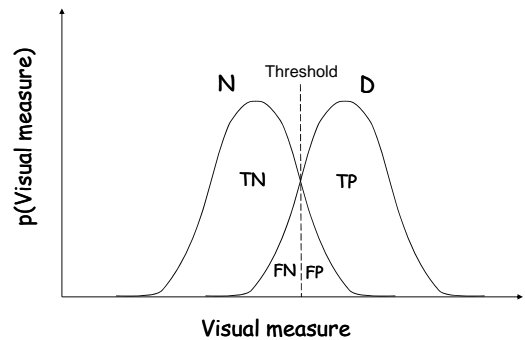
#### Notation

- |     |                             |
|-----|-----------------------------|
| D   | Disease present             |
| "D" | System says disease present |
| N   | Disease absent              |
| "N" | System says disease absent  |
| TP  | True positive               |
| FP  | False positive              |
| TN  | True Negative               |
| FN  | False Negative              |

## Discrimination of Binary Outcomes

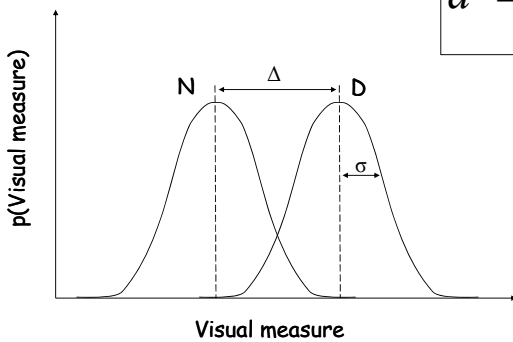


## Discrimination of Binary Outcomes



## Discrimination Index

$$d' = \frac{\Delta}{\sigma}$$



## Sensitivity

- The proportion of positives that are correctly identified by the test

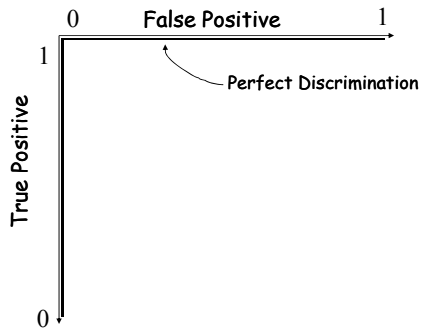
## Specificity

- The proportion of negatives that are correctly identified by the test

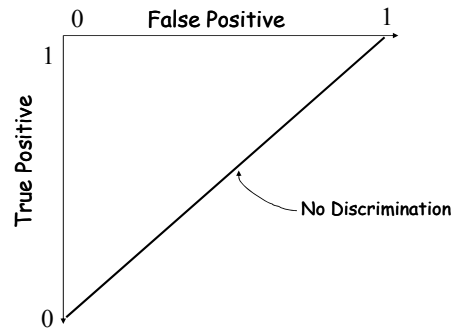
## ROC Curves

- Receiver operating characteristic (ROC) curve
- Plot of True Positive Rate vs. False Positive Rate as its discrimination threshold is varied.
- I.e. (Sensitivity) vs. (1-Specificity)
- Tool to select optimal enhancement/processing.

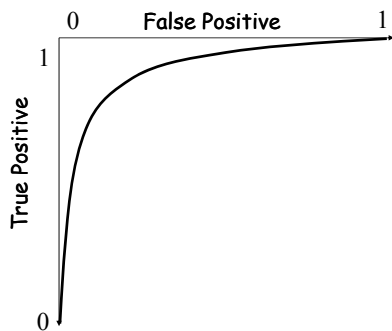
## ROC Curves



## ROC Curves



## ROC Curves

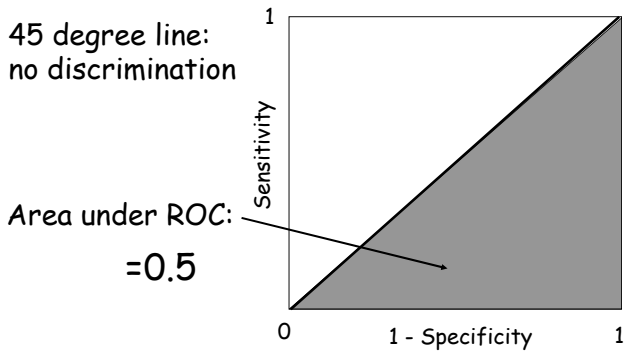


## Area under the ROC?

- An estimate of the discriminatory performance of the system
  - Real outcome is binary
  - Systems' estimates are continuous (0 to 1)
  - All thresholds are considered
- **NOT** an estimate of the probability of the system giving the "right" answer

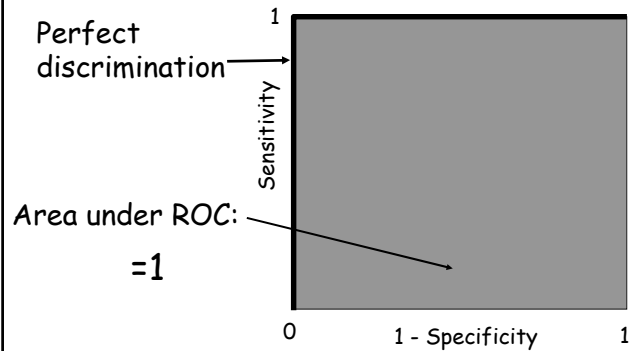
## Area under the ROC

45 degree line:  
no discrimination

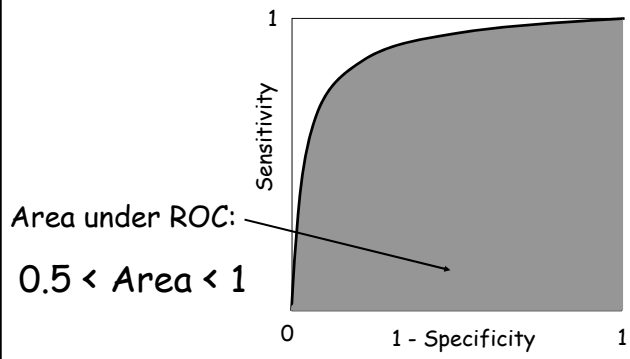


## Area under the ROC?

Perfect  
discrimination



## Area under the ROC



## Summary

- Discrimination
- Discrimination index
- Sensitivity & Specificity
- ROC curves