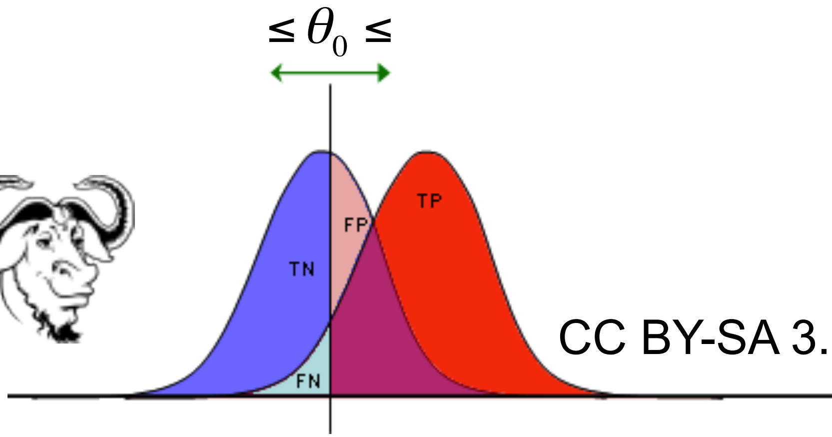
Continuous Example: Temperature Bound => flue yes / no



		Evidence (True Class)	
		pos	**neg**
Classifier prediction (Hypothezised class)	**Hit**	**TP**	**FP**
	Miss	**FN**	**TN**
Column totals		**P**	**N**

Classifier: Decide on disease by varying diagnosis temperature θ_0:

What is the "best" classifier value to indicate: you have the flue?

Red: true positive **(TP)**
high temperature and will have flue
[if a pos. instance is classified as Hit]

Light blue: false negative **(FN)**
too low temp, but will get the flue
[if a pos. instance is classified as Miss]

Strong blue: true negative **(TN)**
too low temp, and no flue
[if a neg. instance is classified as Miss]

Light red: false positives **(FP)**
high temperature but never get it
[if a neg. instance is classified as Hit]

From Confusion table to ROC graph

		True class p	True class n
Hypothesized class	y	True Positives	False Positives
	n	False Negatives	True Negatives
Column totals		P	N

$$\text{FP rate} = \frac{\text{FP}}{\text{N}}$$

$$\text{TP rate} = \frac{\text{TP}}{\text{P}} = \text{Recall}$$

ROC graph uses for x axis == FP rate

ROC graph uses for y axis == TP rate

$$\text{Precision} = \frac{\text{TP}}{\text{TP+FP}}$$

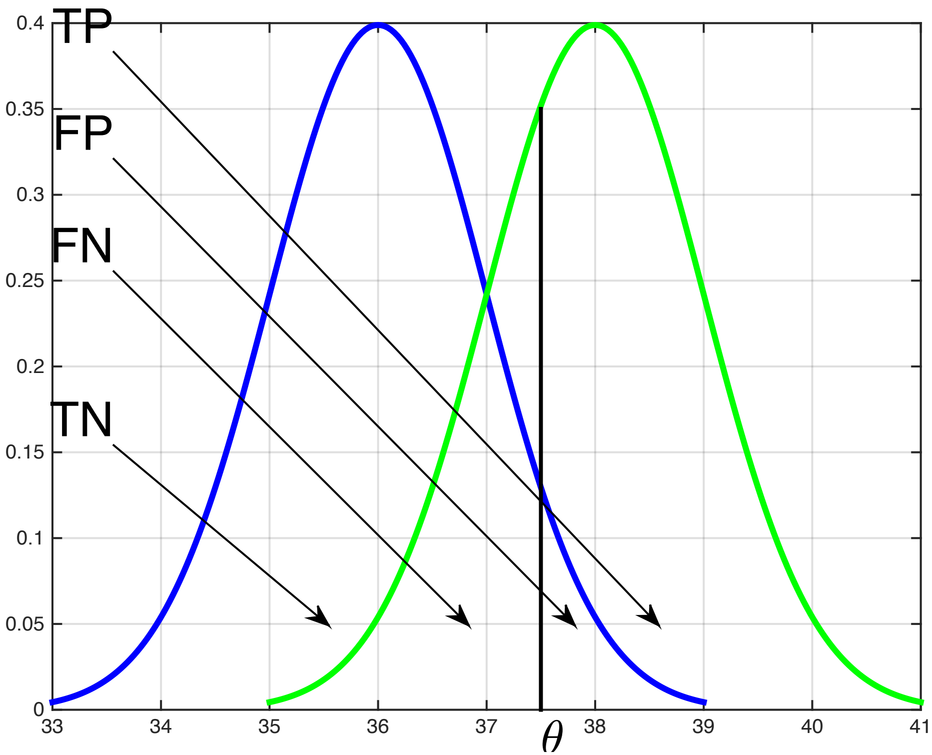
F-score= Precision * Recall

$$\text{Accuracy} = \frac{\text{TP+TN}}{\text{P+N}}$$

From Confusion table to ROC graph

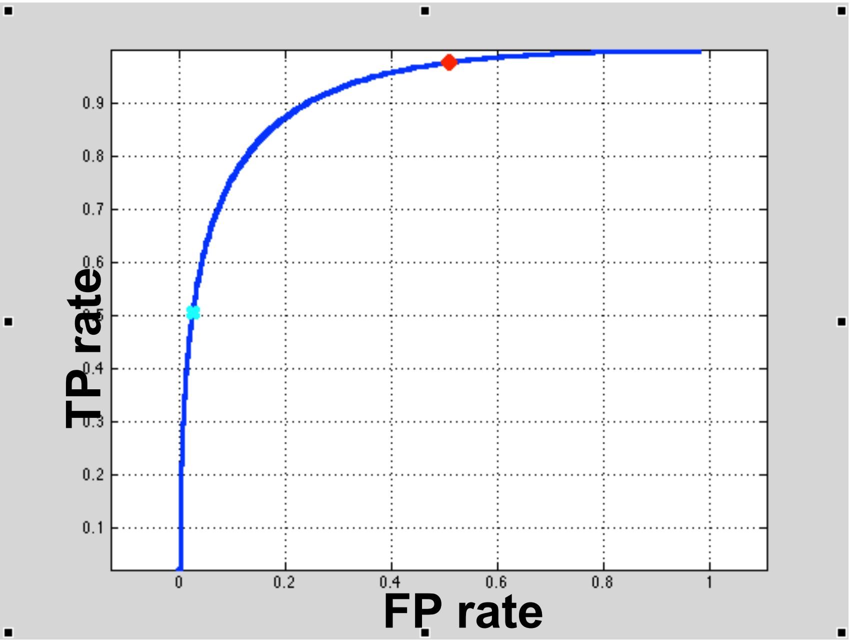
		Condition (as determined by "Gold standard")		
		Condition Positive	Condition Negative	
Test Outcome	Test Outcome Positive	**True Positive**	**False Positive** (Type I error)	Precision = $\frac{\Sigma \text{ True Positive}}{\Sigma \text{ Test Outcome Positive}}$
	Test Outcome Negative	**False Negative** (Type II error)	**True Negative**	Negative predictive value = $\frac{\Sigma \text{ True Negative}}{\Sigma \text{ Test Outcome Negative}}$
		Sensitivity = $\frac{\Sigma \text{ True Positive}}{\Sigma \text{ Condition Positive}}$	**Specificity** = $\frac{\Sigma \text{ True Negative}}{\Sigma \text{ Condition Negative}}$	Accuracy

Data by hand: normpdf



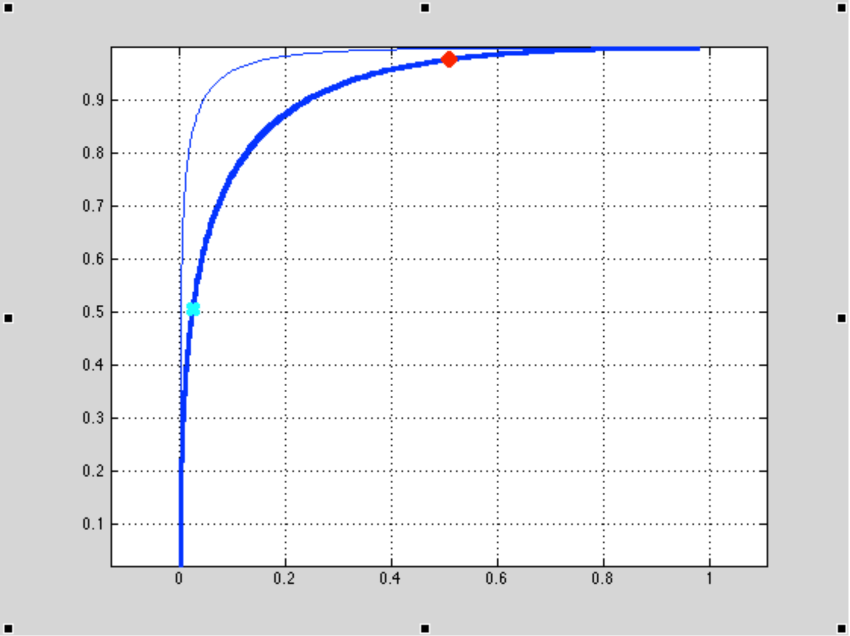

```
%two temperature distributions, healthy and sick
clf;
mu=36;
mu2=38;
sigma=1.0;
sigma2=1.0;
%sample it arround ist modes == peaks
X=linspace(mu-3,mu+3,201);
Y=linspace(mu2-3,mu2+3,201);
plot(X,normpdf(X,mu,sigma),'b','LineWidth',3)
hold on;grid on;
plot(Y,normpdf(Y,mu2,sigma2),'g','LineWidth',3);
plot([37.5 37.5],[0 0.35],'k','LineWidth',2);
% Create textarrow
annotation('textarrow',[0.185
0.376785714285715],...
    [0.424167024167026 0.21],'String',
{'TN'},'FontSize',24);
annotation('textarrow',[0.185
0.501785714285714],...
    [0.630952380952381 0.21],'String',
{'FN'},'FontSize',24);
annotation('textarrow',[0.185
0.596428571428571],...
    [0.764764764764765 0.21],'String',
{'FP'},'FontSize',24);
annotation('textarrow',[0.185
0.671428571428571],...
    [0.891891891891892 0.21],'String',
{'TP'},'FontSize',24);
annotation('textbox',...
    [0.557707572897 0.0547619047619048
0.0311428571428571 0.05],...
    'String','\theta',...
    'LineStyle','none',...
    'FontSize',24,...
    'FontName','Helvetica',...
```

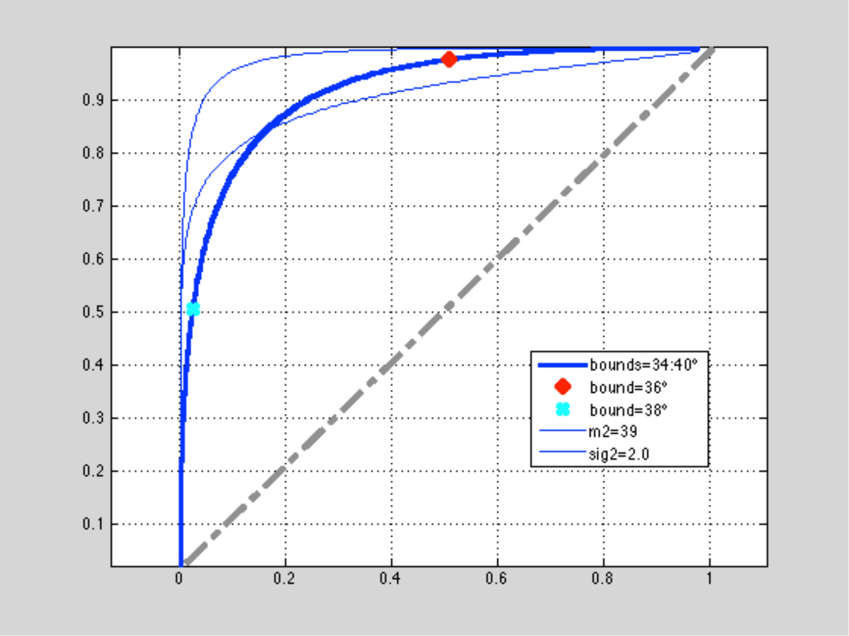
Results: normcdf, ROC by hand




```
bounds=[34:0.02:40];
%these are the values for boundaries
TN=normcdf(bounds,mu,sigma);% BLUE area
FP=1-TN;                              % ROSE area
FN=normcdf(bounds,mu2,sigma2);% CYAN area
TP=1-FN;                               % RED area
TPrate=TP./(TP+FN);% build percentage or rates
FPrate=FP./(FP+TN);%
plot(FPrate,TPrate);axis equal;grid on;
%MY first ROC diagram
hold on
plot(FPrate(100),TPrate(100),'rd','LineWidth',3);
% right in Raw,  is left in ROC
plot(FPrate(200),TPrate(200),'cx','LineWidth',3);
%
```

Results: 2nd ROC for mu2=39°
3rd ROC for sigma2=2.0





Eg.: Application to signals

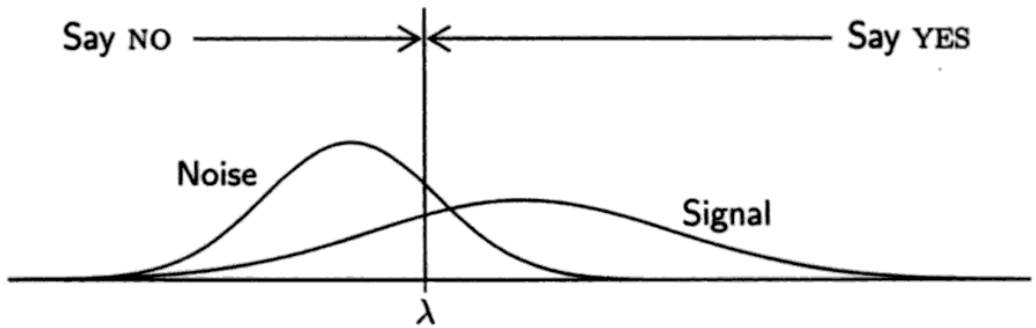


Figure 1.2: The signal and noise distributions of Figure 1.1 shown on a single axis with a decision criterion at the value λ.

$$X_n : random\ varibale\ for\ noise\ trials, density f_n(x)$$

$$X_s : random\ varibale\ for\ signal\ trials, density f_s(x)$$

$$false-alarm\ rate : P_F = P(YES \mid noise) =$$

$$P(X > \lambda \mid noise) = P(X_n > \lambda) = \int_\lambda^\infty f_n(x)\,dx$$

$$= 1 - F_n(\lambda)\ where\ F_n\ is\ Cummulative\ Distribution$$

$$Function\ of\ f_n$$