DATA SCIENCE
DRAWING AN ROC CURVE

Email Score	True Label
0.99	Spam
0.82	Spam
0.65	Spam
0.65	Ham
0.52	Spam
0.22	Spam
0.11	Ham
0.02	Ham

Every email is assigned a "spamminess" score by our classification algorithm. To actually make our predictions, we choose a numeric cutoff for classifying as spam.

An ROC curve will help us

Email Score	True Label	Predicted Label Using 0.5 Cutoff
0.99	Spam	Spam
0.82	Spam	Spam
0.65	Spam	Spam
0.65	Ham	Spam
0.52	Spam	Spam
0.22	Spam	Ham
0.11	Ham	Ham
0.02	Ham	Ham

<u>Specificity</u>: When true label is **ham**, how often is the prediction **correct**?

<u>Sensitivity</u>: When true label is **spam**, how often is the prediction **correct**?

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0.99	Spam
0.82	Spam
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0.22	Spam
0.11	Ham
0.02	Ham

Cutoff	Specificity	Sensitivity
1		
0.9		
0.8		
0.6		
0.5	2/3 = 0.66	4/5 = 0.8
0.2		
0.1		
0		

Specificity: When true label is **ham**, how often is the prediction **correct**?

Sensitivity: When true label is **spam**, how often is the prediction **correct**?

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0.99	Spam
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0.11	Ham
0.02	Ham

Cutoff	Specificity	Sensitivity
1	3/3 = 1	0/5 = 0
0.9	3/3 = 1	1/5 = 0.2
0.8	3/3 = 1	2/5 = 0.4
0.6	2/3 = 0.66	3/5 = 0.6
0.5	2/3 = 0.66	4/5 = 0.8
0.2	2/3 = 0.66	5/5 = 1
0.1	1/3 = 0.33	5/5 = 1
0	0/3 = 0	5/5 = 1

<u>Specificity</u>: When true label is **ham**, how often is the prediction **correct**?

<u>Sensitivity</u>: When true label is **spam**, how often is the prediction **correct**?

Email Score	True Label
0.99	Spam
0.82	Spam
0.65	Spam
0.65	Ham
0.52	Spam
0.22	Spam
0.11	Ham
0.02	Ham

Cutoff	FPR (x-axis)	TPR (y-axis)
1	0	0
0.9	0	0.2
0.8	0	0.4
0.6	0.33	0.6
0.5	0.33	0.8
0.2	0.33	1
0.1	0.66	1
0	1	1

FPR (x-axis) = 1-Specificity

TPR (y-axis) = Sensitivity

Q: On the ROC curve, can you see the cutoff that was used to generate a point?

A: No, that information is not visible.

Email Score	True Label
0.99	Spam
0.98	Spam
0.97	Spam
0.97	Ham
0.96	Spam
0.03	Spam
0.02	Ham
0.01	Ham

Q: Would the ROC curve (and AUC) change if the **scores** changed but the **ordering** remained the same?

A: Not at all! The ROC Curve is only sensitive to **rank ordering** and does not require **calibrated scores**.