



An Exercise

How to make an ROC





How to make an ROC



An ROC starts with probabilities from test cases in a binary classification:

1. Test case probabilities are compared to a probability threshold
2. If a test case probability is greater than the threshold, then the prediction is for the class.
3. A confusion matrix is created. The True Positive rate (TPR) and the False Positive rate (FPR) are calculated.
4. This TPR, FPR pair is one point on the ROC curve.
5. Change the probability threshold and repeat the process.



How to make an ROC

- For this exercise open the Excel workbook, named **HowToMakeAnROC.xls**
- Note that at the bottom of the worksheet are two sets of actual outcomes predicted probabilities. These datasets are called **Exercise 1** and **Exercise 2**.
- Example A and Example B are completed examples and are not part of the exercise.

How to make an ROC

Paste the actual outcomes and the predicted probabilities here.

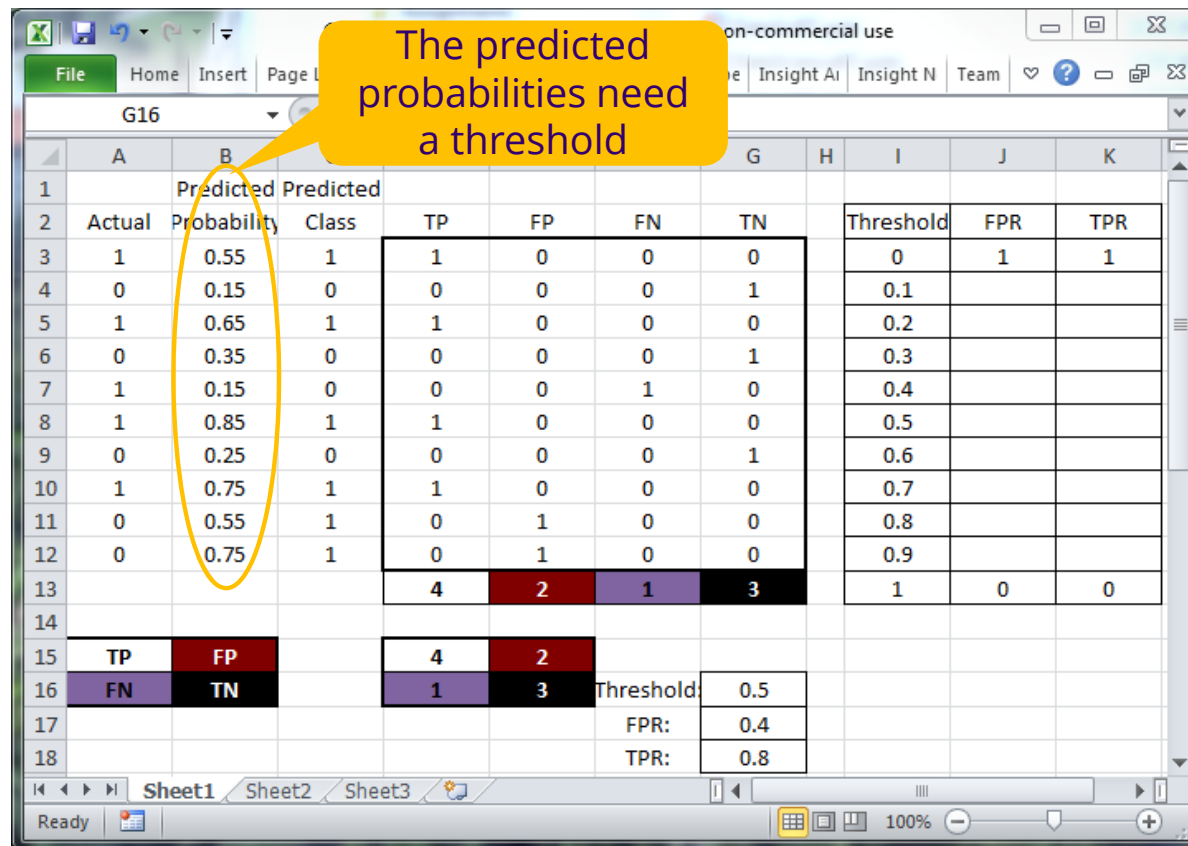
	A	B	C	D	E	F	G	H	I	J	K
1		Predicted	Predicted								
2	Actual	Probability	Class	TP	FP	FN	TN		Threshold	FPR	TPR
3			0	0	0	0	1		0		
4			0	0	0	0	1		0.1		
5			0	0	0	0	1		0.2		
6			0	0	0	0	1		0.3		
7			0	0	0	0	1		0.4		
8			0	0	0	0	1		0.5		
9			0	0	0	0	1		0.6		
10			0	0	0	0	1		0.7		
11			0	0	0	0	1		0.8		
12			0	0	0	0	1		0.9		
13				0	0	0	10		1		
14											
15	TP	FP		0	0						
16	FN	TN		0	10			Threshold:	0.5		
17								FPR:	0		
18								TPR:	#DIV/0!		

How to make an ROC

Paste the actual outcomes and the predicted probabilities here

	A	B		D	E	F	G	H	I	J	K
1		Predicted	Predicted								
2	Actual	Probability	Class	TP	FP	FN	TN		Threshold	FPR	TPR
3	1	0.55	1	1	0	0	0		0	1	1
4	0	0.15	0	0	0	0	1		0.1		
5	1	0.65	1	1	0	0	0		0.2		
6	0	0.35	0	0	0	0	1		0.3		
7	1	0.15	0	0	0	1	0		0.4		
8	1	0.85	1	1	0	0	0		0.5		
9	0	0.25	0	0	0	0	1		0.6		
10	1	0.75	1	1	0	0	0		0.7		
11	0	0.55	1	0	1	0	0		0.8		
12	0	0.75	1	0	1	0	0		0.9		
13				4	2	1	3		1	0	0
14											
15	TP	FP		4	2						
16	FN	TN		1	3						
17						Threshold:	0.5				
18						FPR:	0.4				
						TPR:	0.8				

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G16 0.5

	A	B	C	D	E	F	G	H	I	J	K
1		Predicted	Predicted								
2	Actual	Probability	Class	TP	FP	FN	TN	Threshold	FPR	TPR	
3	1	0.55	1	1	0	0	0	0	1	1	
4	0	0.15	0	0	0	0	1	0.1			
5	1	0.65	1	1	0	0	0	0.2			
6	0	0.35	0	0	0	0	1	0.3			
7	1	0.15	0	0	0	1	0	0.4			
8	1	0.85	1	1	0	0	0	0.5			
9	0	0.25	0	0	0	0	1	0.6			
10	1	0.75	1	1	0	0	0	0.7			
11	0	0.55	1	0	1	0	0	0.8			
12	0	0.75	1	0	1	0	0	0.9			
13				4	2	1	3				
14											
15	TP	FP		4	2						
16	FN	TN		1	3						
17											
18											

Sheet1 Sheet2 Sheet3

Ready

Set the threshold for the predicted probabilities

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Class = Probability > Threshold

	A	B	C	D	E	F	G	H	I	J	K
	Actual	Probability	Predicted Class	TP	FP	FN	TN	Threshold	FPR	TPR	
1											
2	1	0.55	1	1	0	0	0	0	1	1	
3	0	0.15	0	0	0	0	1	0.1			
4	1	0.65	1	1	0	0	0	0.2			
5	0	0.35	0	0	0	0	1	0.3			
6	1	0.15	0	0	0	1	0	0.4			
7	1	0.85	1	1	0	0	0	0.5			
8	0	0.25	0	0	0	0	1	0.6			
9	1	0.75	1	1	0	0	0	0.7			
10	0	0.55	1	0	1	0	0	0.8			
11	0	0.75	1	0	1	0	0	0.9			
12				4	2	1	3	1	0	0	
13											
14											
15	TP	FP		4	2						
16	FN	TN		1	3						
17											
18											

Threshold: 0.5
FPR: 0.4
TPR: 0.8

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Compare the
predicted class
to the actual
values

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	A	B	C	D	E	F	G	H	I	J	K
1		Predicted	Predicted								
2	Actual	Probability	Class	TP	FP	FN	TN	Threshold	FPR	TPR	
3	1	0.55	1	1	0	0	0	0	1	1	
4	0	0.15	0	0	0	0	1	0.1			
5	1	0.65	1	1	0	0	0	0.2			
6	0	0.35	0	0	0	0	1	0.3			
7	1	0.15	0	0	0	1	0	0.4			
8	1	0.85	1	1	0	0	0	0.5			
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11	0	0.55	1	0	1	0	0	0.8			
12	0	0.75	1	0	1	0	0	0.9			
13				4	2	1	3	1	0	0	
14											
15	TP	FP		4	2						
16	FN	TN		1	3						
17						Threshold:	0.5				
18						FPR:	0.4				
						TPR:	0.8				

Sheet1 Sheet2 Sheet3

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The comparison has four outcomes

The spreadsheet displays data for an ROC curve. The first three columns (A, B, C) are circled in yellow. The data rows (3-12) show individual predictions with their probabilities and classes. Row 13 summarizes the counts for each outcome. Rows 15-16 show the counts for True Positives (TP), False Positives (FP), False Negatives (FN), and True Negatives (TN). Rows 17-18 show the calculated FPR and TPR for a threshold of 0.5.

Actual	Probability	Class	TP	FP	FN	TN	Threshold	FPR	TPR
1	0.55	1	1	0	0	0	0	1	1
0	0.15	0	0	0	0	1	0.1		
1	0.65	1	1	0	0	0	0.2		
0	0.35	0	0	0	0	1	0.3		
1	0.15	0	0	0	1	0	0.4		
1	0.85	1	1	0	0	0	0.5		
0	0.25	0	0	0	0	1	0.6		
1	0.75	1	1	0	0	0	0.7		
0	0.55	1	0	1	0	0	0.8		
0	0.75	1	0	1	0	0	0.9		
			4	2	1	3	1	0	0
			TP	FP	FN	TN			
			4	2	1	3	Threshold:	0.5	
						FPR:	0.4		
						TPR:	0.8		

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TP:
(Class == 1) &
(Actual == 1)

FP:
(Class == 1) &
(Actual == 0)

FN:
(Class == 0) &
(Actual == 1)

TN:
(Class == 0) &
(Actual == 0)

	Actual	Probability	Class	TP	FP	FN	TN	Threshold	FPR	TPR
3	1	0.55	1	1	0	0	0	0	1	1
4	0	0.15	0	0	0	0	1	0.1		
5	1	0.65	1	1	0	0	0	0.2		
6	0	0.35	0	0	0	0	1	0.3		
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12	0	0.75	1	0	1	0	0	0.9		
13				4	2	1	3	1	0	0
15	TP	FP		4	2					
16	FN	TN		1	3					
						Threshold:	0.5			
						FPR:	0.4			
						TPR:	0.8			

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G16 fx 0.5

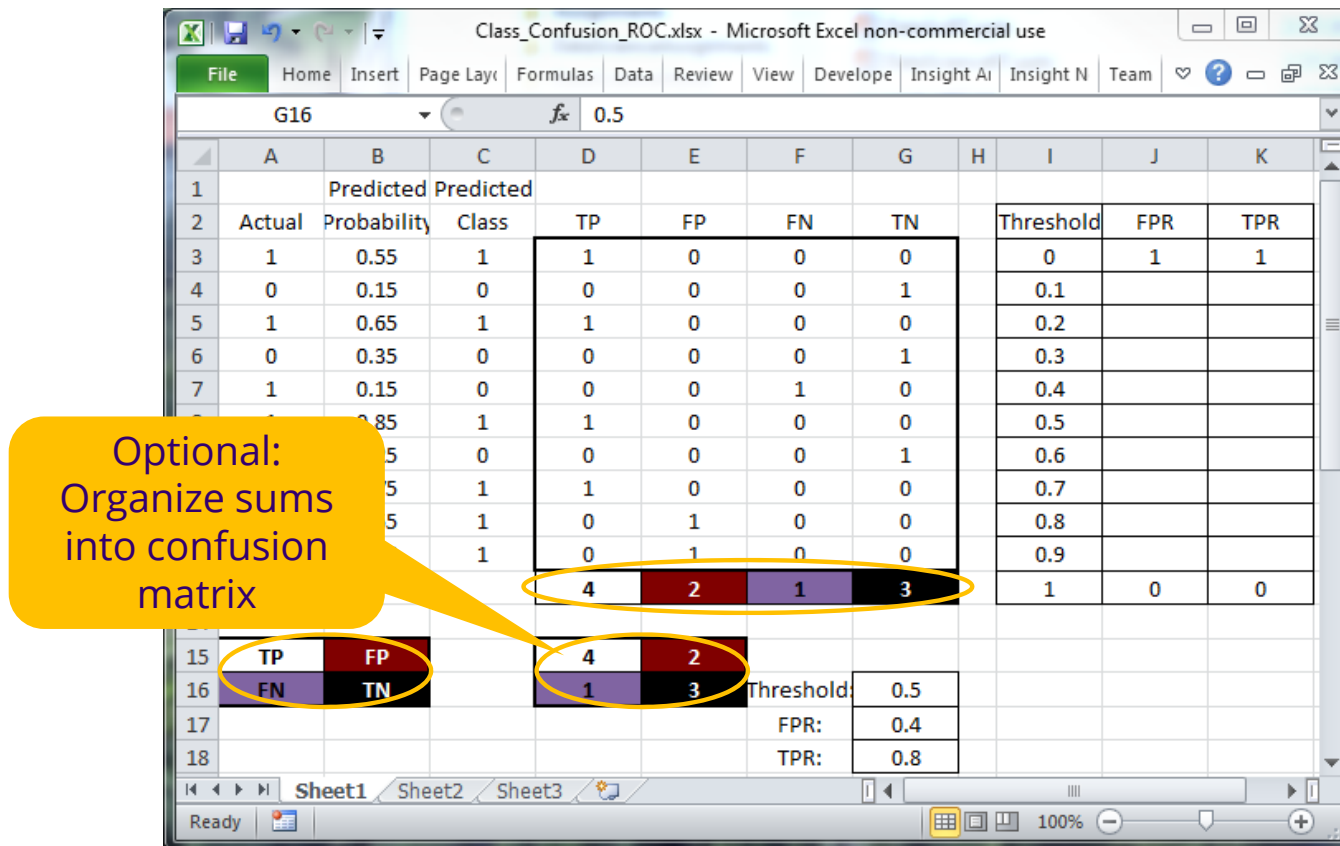
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2	Actual	Probability	Class	TP	FP	FN	TN	Threshold	FPR	TPR	
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12			1	0	1	0	0	0.9			
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14											
15	TP	FP		4	2						
16	FN	TN		1	3						
17						Threshold:	0.5				
18						FPR:	0.4				
						TPR:	0.8				

Sum(TP)
Sum(FP)
Sum(FN)
Sum(TN)

Sheet1 Sheet2 Sheet3

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	A	B	C	D	E	F	G	H	I	J	K
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13				4	2	1	3				
14											
15	TP	FP		4	2						
16	FN	TN		1	3						
17						Threshold	0.5				
18						FPR:	0.4				
						TPR:	0.8				

FPR = FP/(FP + TN)

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11	0	0.55	1	0	1	0	0	0.8			
12	0	0.75	1	0	1	0	0				
13				4	2	1	3				
14											
15	TP	FP		4	2						
16	FN	TN		1	3						
17						Threshold:	0.5				
18						FPR:	0.4				
						TPR:	0.8				

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TPR = TP/(TP + FN)

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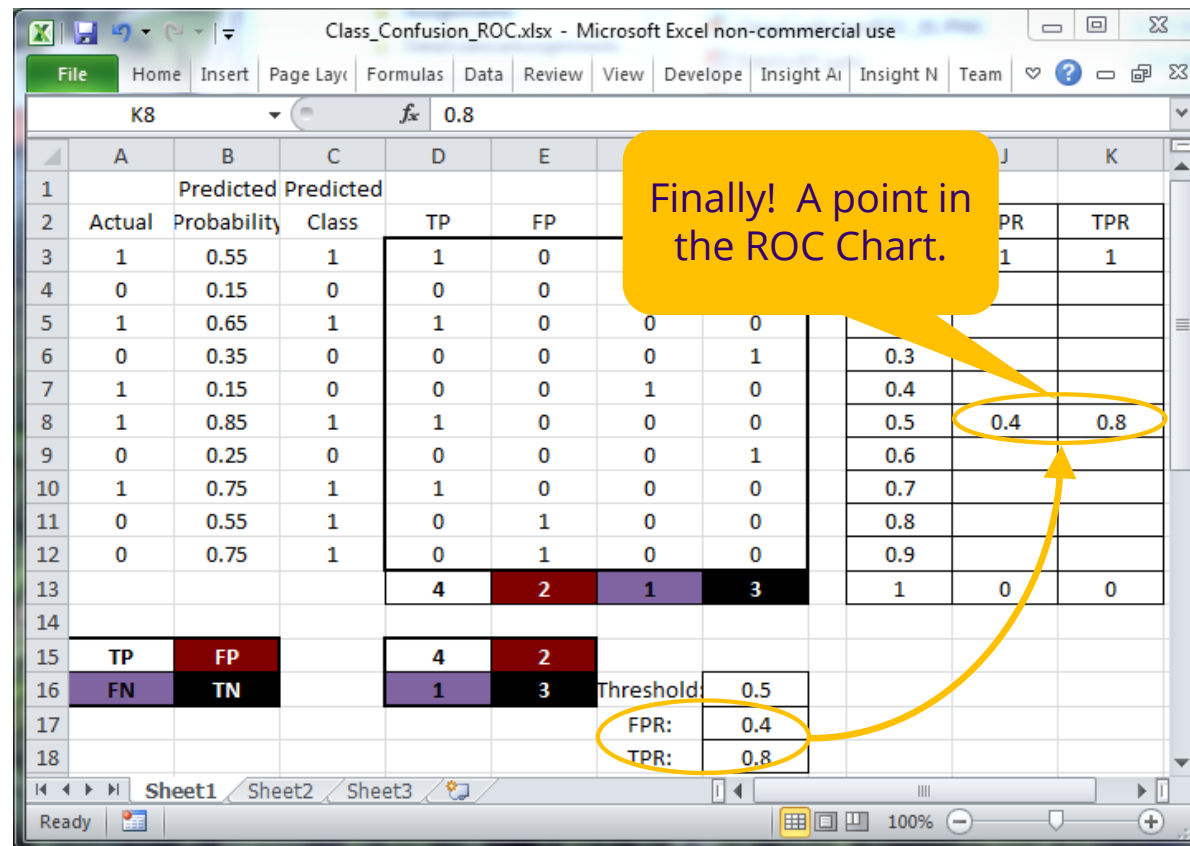
G16 fx 0.5

	A	B	C	D	E	F	G	H	I	J	K
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2	Actual	Probability	Class	TP	FP	FN	TN	Threshold	FPR	TPR	
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4	0	0.15	0	0	0	0	1	0.1			
5	1	0.65	1	1	0	0	0	0.2			
6	0	0.35	0	0	0	0	1	0.3			
7	1	0.15	0	0	0	1	0	0.4			
8	1	0.85	1	1	0	0	0	0.5			
9	0	0.25	0	0	0	0	1	0.6			
10	1	0.75	1	1	0	0	0	0.7			
11	0	0.55	1	0	1	0	0	0.8			
12	0	0.75	1	0	1	0	0	0.9			
13				4	2	1	3	1	0	0	
14											
15	TP	FP		4	2						
16	FN	TN		1	3						
17						Threshold:	0.5				
18						FPR:	0.4				
						TPR:	0.8				

Sheet1 Sheet2 Sheet3

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K9 0.6

	A	B	C	D	E	F	G	H	I	J	K
1		Predicted	Predicted								
2	Actual	Probability	Class	TP	FP	FN	TN	Threshold	FPR	TPR	
3	1	0.55	0	0	0	1	0	0	1	1	
4	0	0.15	0	0	0	0	1	0.1			
5	1	0.65	1	1	0	0	0	0.2			
6	0	0.35	0	0	0	0	1	0.3			
7	1	0.15	0	0	0	1	0	0.4			
8	1	0.85	1	1	0	0	0	0.5	0.4	0.8	
9	0	0.25	0	0	0	0	1	0.6	0.2	0.6	
10	1	0.75	1	1	0	0	0	0.7			
11	0	0.55	0	0	0	0	1	0.8			
12	0	0.75	1	0	1	0	0	0.9			
13				3	1	2	4	1	0	0	
14											
15	TP	FP		3	1						
16	FN	TN		2	4						
17								Threshold:	0.6		
18								FPR:	0.2		
								TPR:	0.6		

Sheet1 Sheet2 Sheet3

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Repeat the process for all thresholds