Classification Error Metrics

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Measure	Formula
accuracy, recognition rate	$\frac{TP+TN}{P+N}$
error rate, misclassification rate	$\frac{FP+FN}{P+N}$
sensitivity, true positive rate, recall	$\frac{TP}{P}$
specificity, true negative rate	$\frac{TN}{N}$
precision	$\frac{TP}{TP+FP}$
F, F_1, F-score, harmonic mean of precision and recall	$\frac{2 \times precision \times recall}{precision + recall}$
F_β, where β is a non-negative real number	$\frac{(1+\beta^2) \times precision \times recall}{\beta^2 \times precision + recall}$

Predicted class

Actual class		yes	no	Total
	yes	TP	FN	P
	no	FP	TN	N
	Total	P'	N'	P + N

Example 1

- TP = 45, TN = 40, FN = 10, FP = 5

- P = 55, N = 45

- Accuracy = (45 + 40) / (55 + 45) = 85/100 = 0.85

- Precision = 45 / (45 + 5) = 45/50 = 0.9

- Recall = 45 / 55 = 0.82

- F1 = 2 ((0.9 * 0.82) / (0.9 + 0.82)) = 2 (0.738 / 1.72) = 0.86

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specificity, true negative rate	$\frac{TN}{N}$
precision	$\frac{TP}{TP+FP}$
F, F_1, F-score, harmonic mean of precision and recall	$\frac{2 \times precision \times recall}{precision+recall}$
F_β, where β is a non-negative real number	$\frac{(1+\beta^2) \times precision \times recall}{\beta^2 \times precision+recall}$

Predicted class

Actual class		yes	no	Total
	yes	TP	FN	P
	no	FP	TN	N
	Total	P'	N'	P + N

Example 2

- TP = 0, TN = 99, FN = 1, FP = 0

- P = 1, N = 99

- Accuracy = (0 + 99) / (1 + 99) = 99/100 = 0.99

- Precision = 0 / (0 + 0) = 0

- Recall = 0 / 1 = 0

- F1 = 2 ((0 * 0) / (0 + 0)) = 2 (0 / 0) = 0

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specificity, true negative rate	$\frac{TN}{N}$
precision	$\frac{TP}{TP+FP}$
F, F_1, F-score, harmonic mean of precision and recall	$\frac{2 \times precision \times recall}{precision+recall}$
F_β, where β is a non-negative real number	$\frac{(1+\beta^2) \times precision \times recall}{\beta^2 \times precision+recall}$

Predicted class

Actual class		yes	no	Total
	yes	TP	FN	P
	no	FP	TN	N
	Total	P'	N'	P + N

Topics

- Error Types
- Under-sample (class-based or near-miss algorithm)
- Over-sample (SMOTE algorithm)
- Uder-sample and over-sample