DATA 301: Precision/Recall, F1 Score, Confusion Matrix

Topics

Classification metrics
Accuracy, and why it's not as useful
Precision/Recall
F1 Score
Confusion Matrix

Classification

These metrics apply to classification not regression problems.

Classification: predict a class
Regression: Predict a number

Accuracy, and why it's not as useful

For Classification: It's a fine measure if you have a balanced dataset. That is roughly the same number of every class.

Accuracy starts to fail if you have an unbalanced dataset, for instance

- Cancer diagosis
- Or credit card fraud

For each of these datasets your model can always predict the majority class. (The more unbalanced, the better the accuracy)

A better way- Precision/Recall/F1

Precision: Out of all found how accurate are you?

$$P = \frac{T_p}{T_p + F_p}$$

Recall: How accurate if you consider all?

$$R = \frac{T_p}{T_p + F_n}$$

F1 score: The harmonic mean of precision and recall

$$F1 = 2\frac{P \times R}{P + R}$$

Tp true positives
Fp false positives
Tn true negatives
Fn false negatives

Precision/Recall/F1

$$P = \frac{T_p}{T_p+F_p} \qquad R = \frac{T_p}{T_p+F_n} \qquad F1 = 2\frac{P \times R}{P+R}$$

Example: If a database has 100 items, 60 of which are relevant.

If your algorithm find 50 items, 40 of which are relevant then

P= 40/(40+10) =0.8
R= 40/60 =.66
F1= 2*(.8*.66)/(.8+.66) = .723

You strive for high precision and recall

Precision/Recall/F1 for Multiple classes

When you have more than 2 classes:

Precision: Sum of all the true positives over the sum of all the true positives plus the sum of all the true negatives

Recall: Sum of all the true positives over the sum of all the true positives plus the sum of all the false negatives

F1 score: Still the harmonic mean of precision and recall

Precision/Recall/F1 for Multiple classes Example

A multiclass classification problem with 3 classes.
A,B,C
With a 1:1:100 class ratio (100 times as many C's as A's)

If a dataset has 10,000 C's it will have 100 A's and B's

Precision/Recall/F1 for Multiple classes Example

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If a dataset has 10,000 C's it will have 100 A's and B's

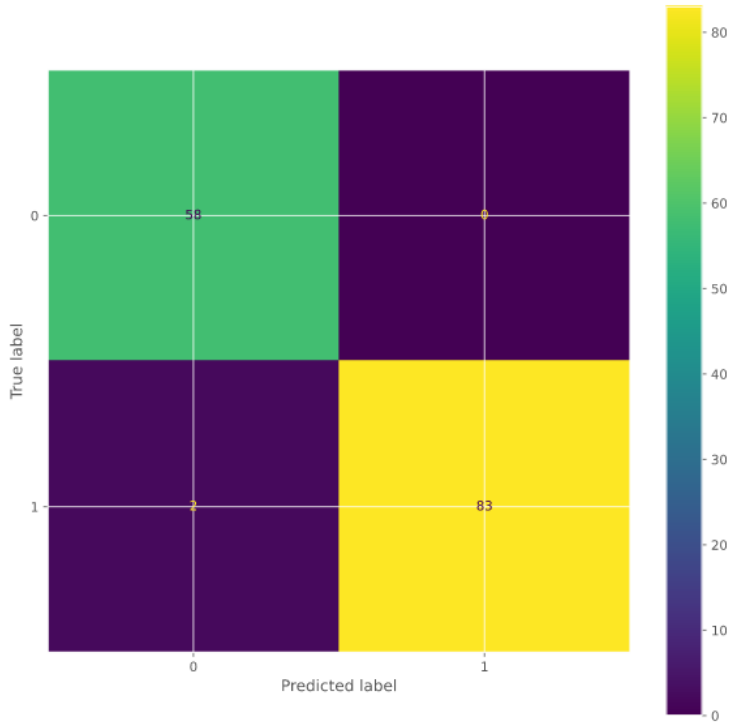
$$P = \frac{T_p}{T_p + F_p}$$

A model predicts 70 A's, 50 are correct and 20 wrong
Predicts 150 B's, 99 are correct and 51 wrong

Precision=(50 +99)/((50+99) + (20 + 51))
=.677

Confusion Matrix

Very simple display:
shows the number right and wrong for every class



Summary

Accuracy is misleading, especially if your dataset is imbalanced
Precision/Recall
F1 Score
Confusion Matrix- just a visual way to check your models predictions against correct values for all classes