Classification Metrics: Precision, Recall, F1-Score and Support

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1 Introduction

In machine learning, evaluating the performance of classification models is crucial. Metrics such as Precision, Recall, F1-Score, and Support play a significant role in understanding the model's performance. This document provides detailed explanations of these metrics.

2 Precision

Precision measures the accuracy of positive predictions. It's defined as the ratio of correctly predicted positive observations to the total predicted positives.

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

Where:

- TP - True Positives: Correct positive predictions.

- FP - False Positives: Negative instances incorrectly predicted as positive.

High precision relates to a low false positive rate and is crucial when the cost of a false positive is high.

3 Recall

Recall, or Sensitivity, measures the model's ability to find all the relevant cases (positives). It's defined as the ratio of correctly predicted positive observations to all the actual positives.

$$Recall = \frac{TP}{TP + FN}$$

Where:

- FN - False Negatives: Positive instances incorrectly predicted as negative.

High recall indicates that the class is correctly recognized, crucial when the cost of a false negative is high.

4 F1-Score

F1-Score is the harmonic mean of Precision and Recall. It balances both metrics and is defined as:

$$F1 - Score = 2 \cdot \frac{Precision \cdot Recall}{Precision + Recall}$$

An F1 score reaches its best at 1 (perfect precision and recall) and worst at 0.

5 Support

Support is the number of actual occurrences of the class in the dataset. It's not a performance measure but provides insight into the evaluation context:

- For each class: Indicates the instances' presence in the dataset.

- Total Support: Total number of instances, giving scale to the evaluation.

6 Confusion Matrix

The confusion matrix is a 2x2 table used to describe the performance of a classification model. It includes the following terms:

	Predicted Positive	Predicted Negative
Actual Positive	TP	FN
Actual Negative	FP	TN

Where:

- TP - True Positives: Correct positive predictions.

- TN - True Negatives: Correct negative predictions.

- FP - False Positives: Negative instances incorrectly predicted as positive.

- FN - False Negatives: Positive instances incorrectly predicted as negative.

Support is crucial for understanding the dataset, especially in the case of imbalanced datasets.