**Calculating Precision and Recall for 3-Class Problems**

**Understanding Precision and Recall**

Precision and recall are two fundamental metrics used to evaluate the performance of a classification model. Precision measures the proportion of true positives among all predicted positive instances, while recall measures the proportion of true positives among all actual positive instances.

**Calculating Precision and Recall for 3-Class Problems**

To calculate precision and recall for a 3-class problem, we need to consider the following:

* True Positives (TP): The number of instances correctly predicted for each class.
* False Positives (FP): The number of instances incorrectly predicted for each class.
* False Negatives (FN): The number of instances missed by the model for each class.

**Class-Wise Precision and Recall**

For each class, we can calculate precision and recall as follows:

* Precision = TP / (TP + FP)
* Recall = TP / (TP + FN)

Let's consider an example with three classes: A, B, and C.

|  |  |  |  |
| --- | --- | --- | --- |
| Class | TP | FP | FN |
| A | 30 | 20 | 10 |
| B | 60 | 15 | 25 |
| C | 40 | 10 | 30 |

For class A:

* Precision = 30 / (30 + 20) = 0.6
* Recall = 30 / (30 + 10) = 0.75

For class B:

* Precision = 60 / (60 + 15) = 0.8
* Recall = 60 / (60 + 25) = 0.7059

For class C:

* Precision = 40 / (40 + 10) = 0.8
* Recall = 40 / (40 + 30) = 0.5714

**Averaging Techniques**

To obtain a single precision and recall score for the entire model, we can use averaging techniques.

**Macro Averaging**: Calculate the precision and recall for each class and then compute the macro average by taking the arithmetic mean of the class-wise precision and recall values.

**Micro Averaging:** Calculate the precision and recall by considering the total TP, FP, and FN across all classes.

**Macro Averaging Example**

Using the class-wise precision and recall values calculated earlier:

Macro Precision = (0.6 + 0.8 + 0.8) / 3 = 0.7333

Macro Recall = (0.75 + 0.7059 + 0.5714) / 3 = 0.6758

**Micro Averaging Example**

Using the total TP, FP, and FN across all classes:

|  |  |  |  |
| --- | --- | --- | --- |
| TP | FP | FN |  |
| Total | 130 | 45 | 65 |

Micro Precision = 130 / (130 + 45) = 0.7436

Micro Recall = 130 / (130 + 65) = 0.6667

**Conclusion**

Calculating precision and recall for 3-class problems involves computing class-wise precision and recall values and then using averaging techniques to obtain a single score for the entire model. By understanding these concepts and calculations, you can effectively evaluate the performance of your classification models.