Classification metrics optimization: Logloss and accuracy

Classification metrics optimization

- Logloss
- Accuracy
- AUC
- (Quadratic weighted) Kappa

Logloss

$$\text{LogLoss} = -\frac{1}{N}\sum_{i=1}^{N} y_i \log(\hat{y}_i) + (1 - y_i) \log(1 - \hat{y}_i)$$

How do you optimize it?

Just run the right model!
(or calibrate others)

Logloss

- **Tree-based**

  Random forest classifier predictions turn out to be quite bad in terms of logloss. But there is a way to make them better, we can calibrate the predictions to better fit logloss.

  `XGBoost, LightGBM`

  ~~`sklearn.RandomForestClassifier`~~

- **Linear models**

  `sklearn.<>Regression`

  `sklearn.SGDRegressor`

  `Vowpal Wabbit`

- **Neural nets**

  `PyTorch, Keras, TF,` etc.

Synonyms: Logistic loss

Read the docs!

Logloss

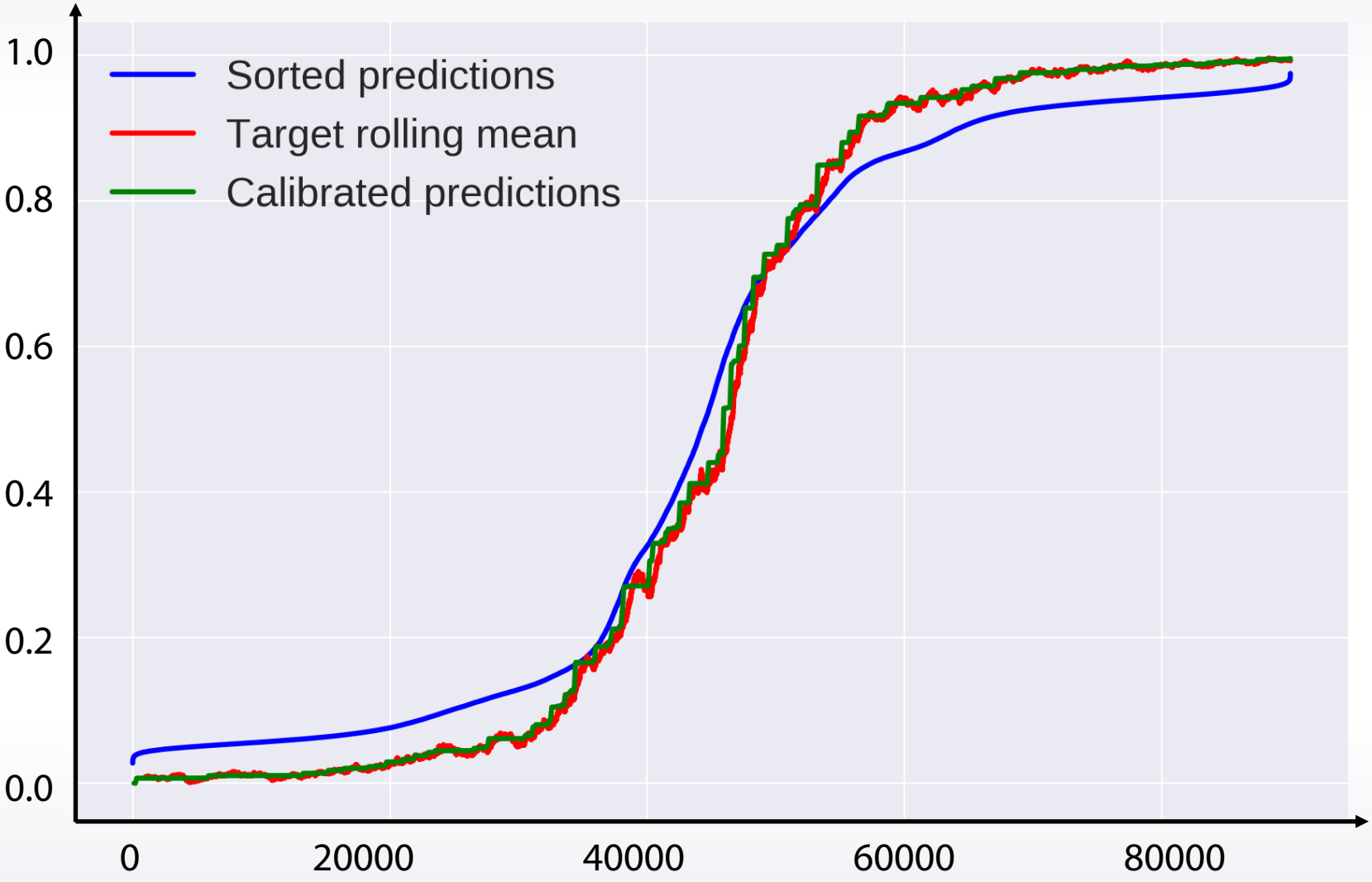
Correct probabilities:

- Take all objects with score e.g. ~ 0.8
  - 80% of them of class 1
  - 20% of them class 0

Incorrect probabilities:

- Take all objects with score e.g. ~ 0.8
  - 50% of them of class 1
  - 50% of them of class 0

Probability calibration



Probability calibration

- Platt scaling
  - Just fit Logistic Regression to your predictions (like in stacking)
- Isotonic regression
  - Just fit Isotonic Regression to your predictions (like in stacking)
- Stacking
  - Just fit XGBoost or neural net to your predictions

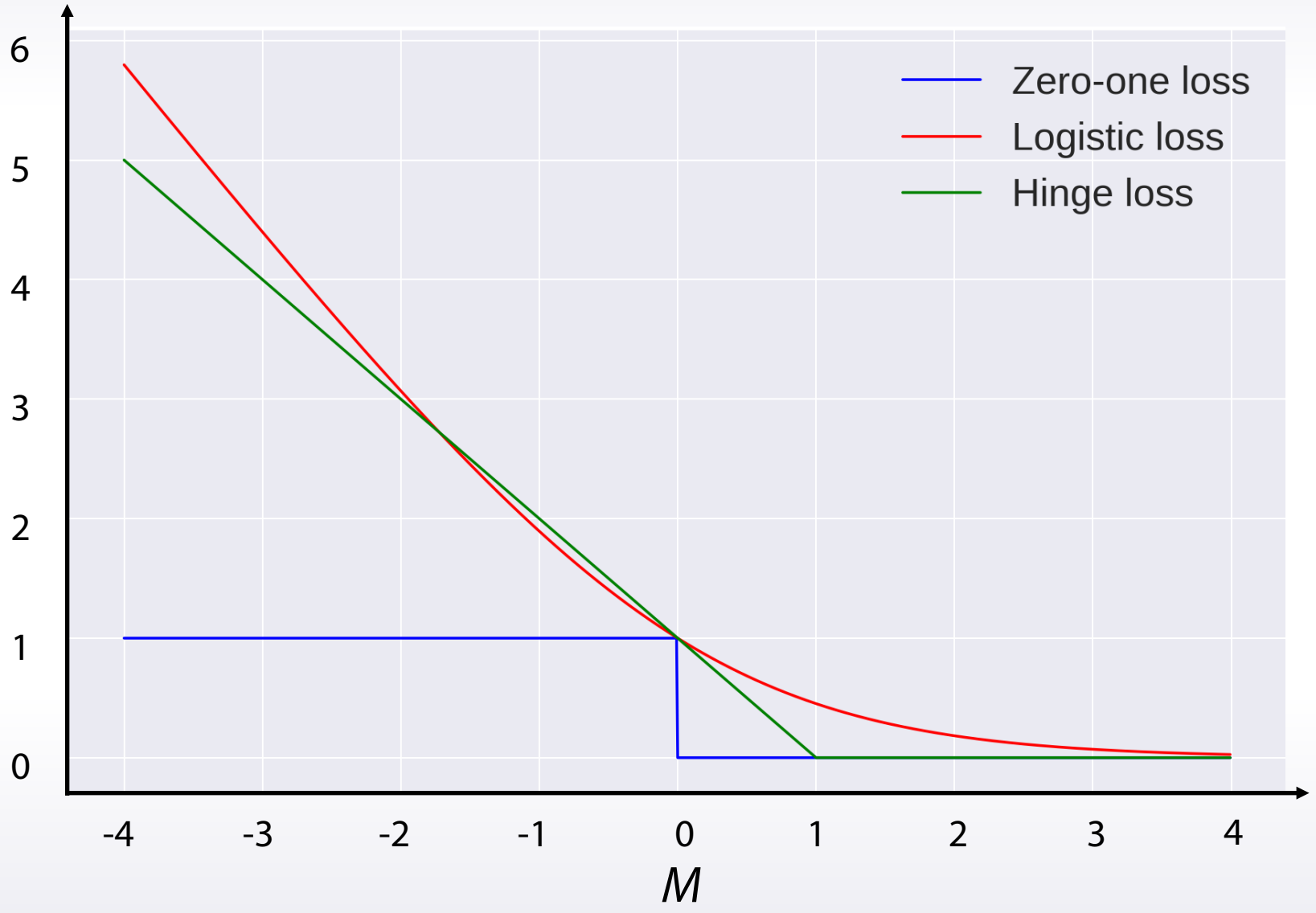
Accuracy

$$\text{Accuracy} = \frac{1}{N}\sum_{i=1}^{N}[\hat{y}_i = y_i]$$

How do you optimize it?

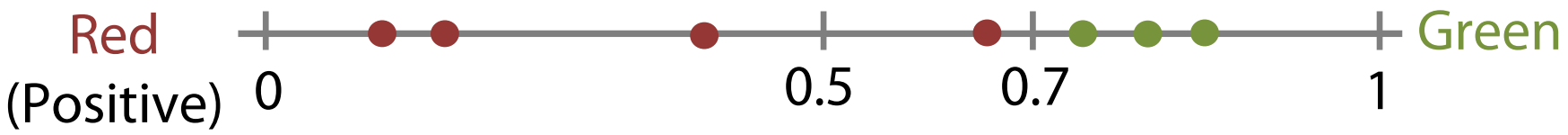
Fit any metric and tune treshold!

Accuracy



Accuracy

$$\text{Accuracy} = \frac{1}{N}\sum_{i=1}^{N}[[f(x) > b] = y_i]$$



$$b = 0.5 \quad \Rightarrow \quad \text{Accuracy} = \frac{6}{7}$$

$$b = 0.7 \quad \Rightarrow \quad \text{Accuracy} = 1$$

Conclusion

- Logloss
- Accuracy
- AUC
- (Quadratic weighted) Kappa