

JOURNAL ARTICLE CORRECTED PROOF

Loss function influence on hyperparameter optimization for observational healthcare prediction models

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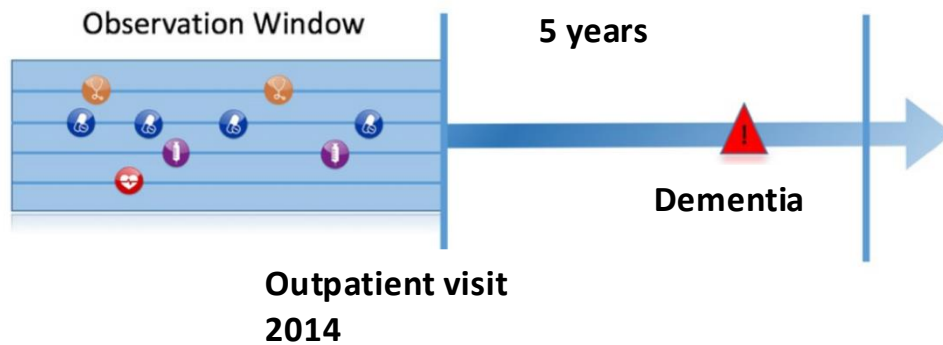
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WHAT IS A PREDICTION MODEL?

They answer questions like: "For patients (55-84 y) with their first outpatient visit in 2014, What is their risk of dementia within 5 years"



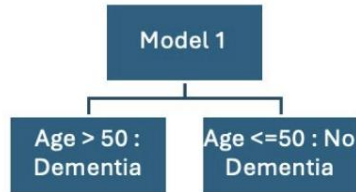
Things that impact your model:

- Training data
- Algorithm:
 - Gradient boosting
 - Decision tree
 - Adaboost
 - Light gradient boosting
- **Hyperparameters!**

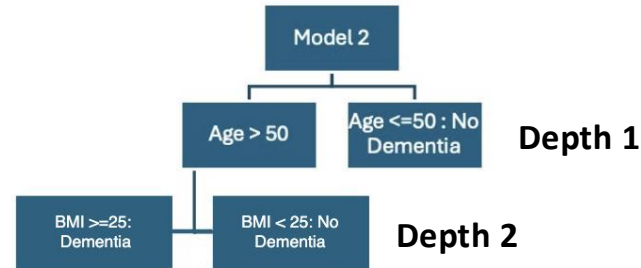
Prediction models can aid medical decision making and improve healthcare.

HYPERPARAMETERS INFLUENCE COMPLEXITY OF THE MODEL

Hyperparameter: Depth = 1



Hyperparameter: Depth = 2

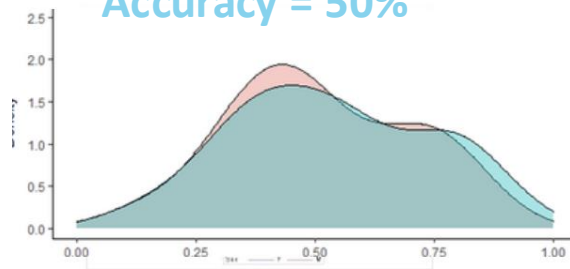


Choice of hyperparameter

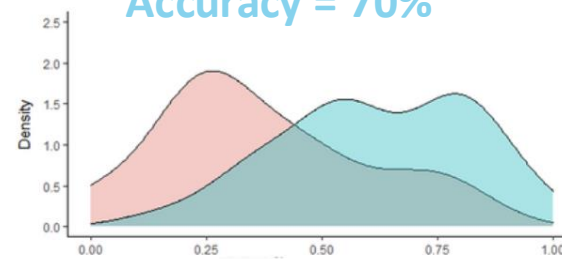
Impacts the model complexity

Impacts model performance.

Accuracy = 50%



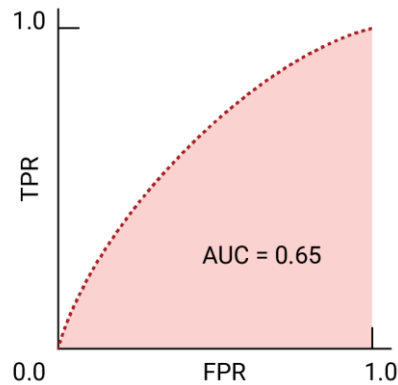
Accuracy = 70%



The hyperparameter loss function is used to pick the hyperparameter and therefore impacts final model performance – but the loss function is rarely investigated

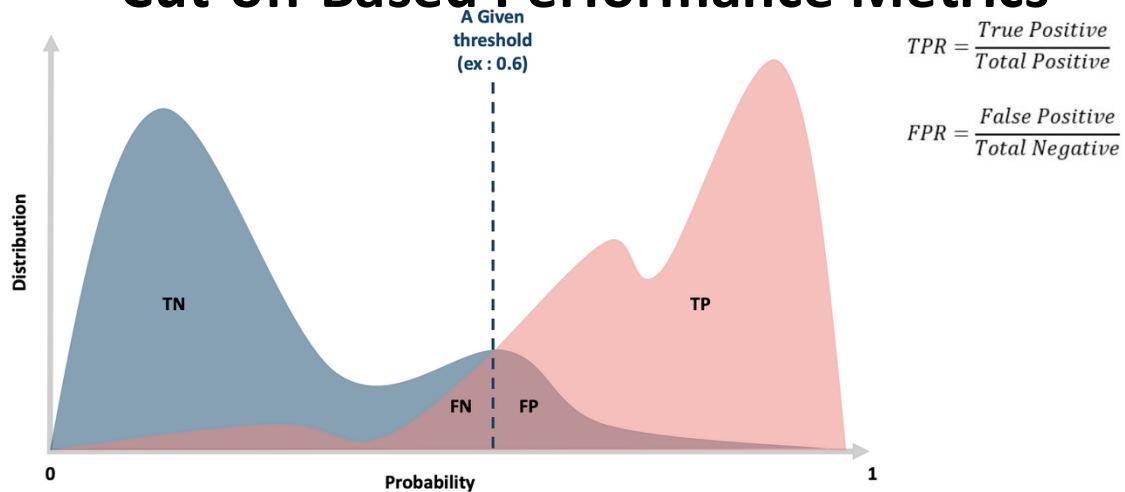
WE CAN EVALUATE PREDICTION MODELS USING MULTIPLE METRICS, BUT WHAT IS IMPORTANT FOR YOUR PREDICTION TASK?

Overall Performance Metrics

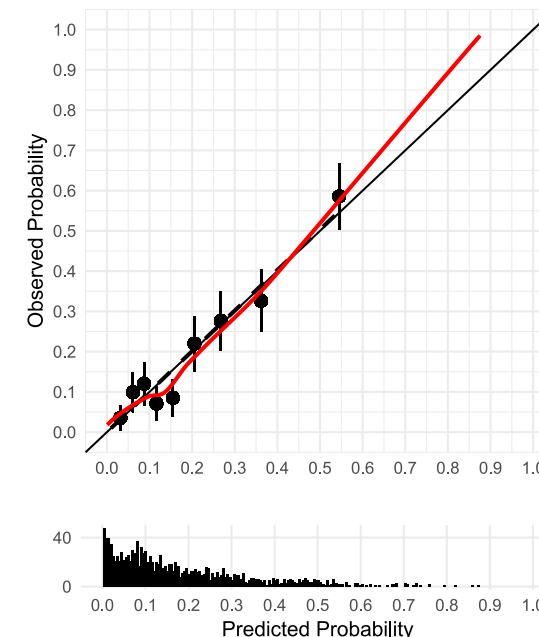


- AUROC – used most frequently, but depending on model use, other metrics may be better.

Cut-off Based Performance Metrics

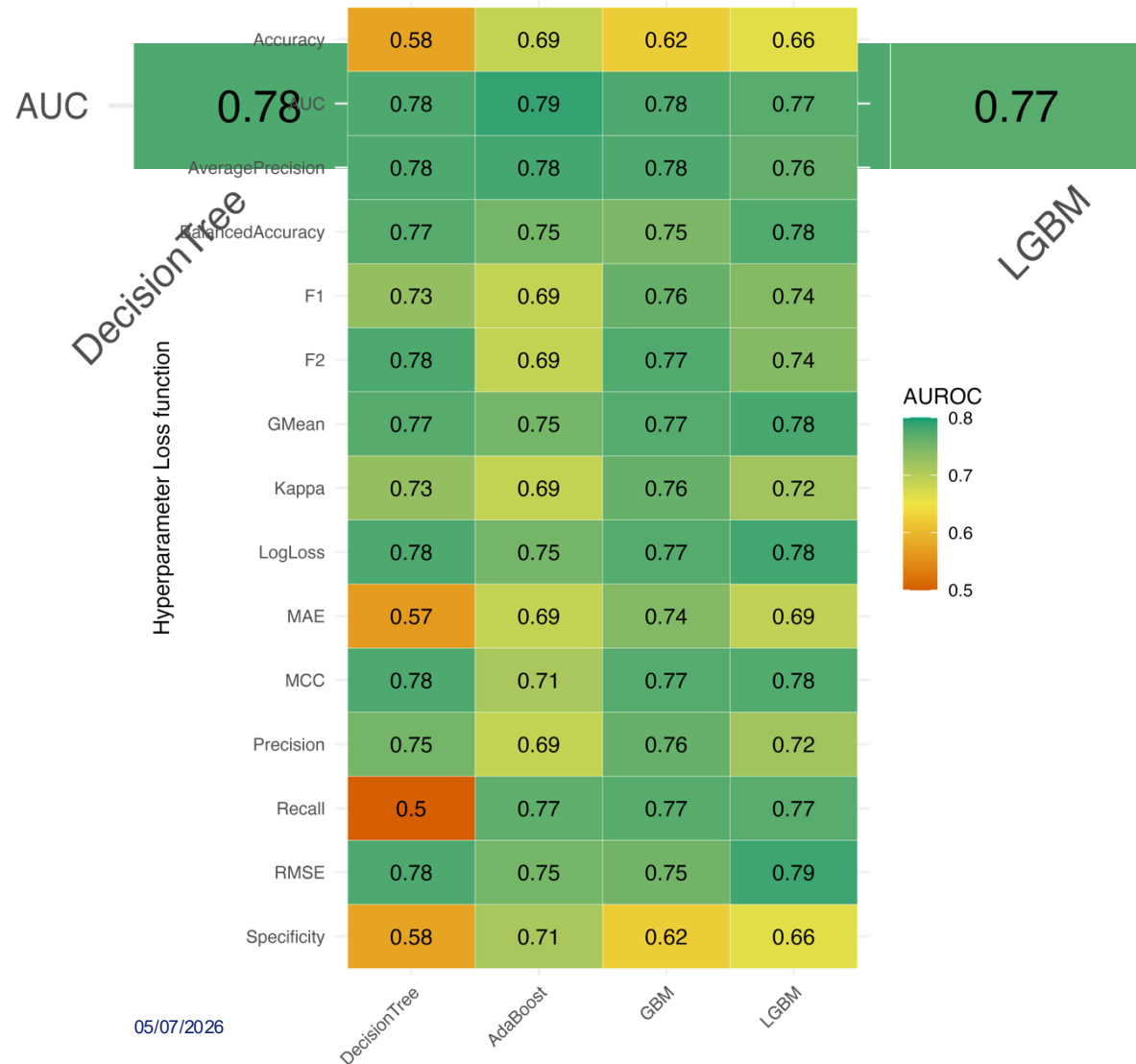


Calibration metrics

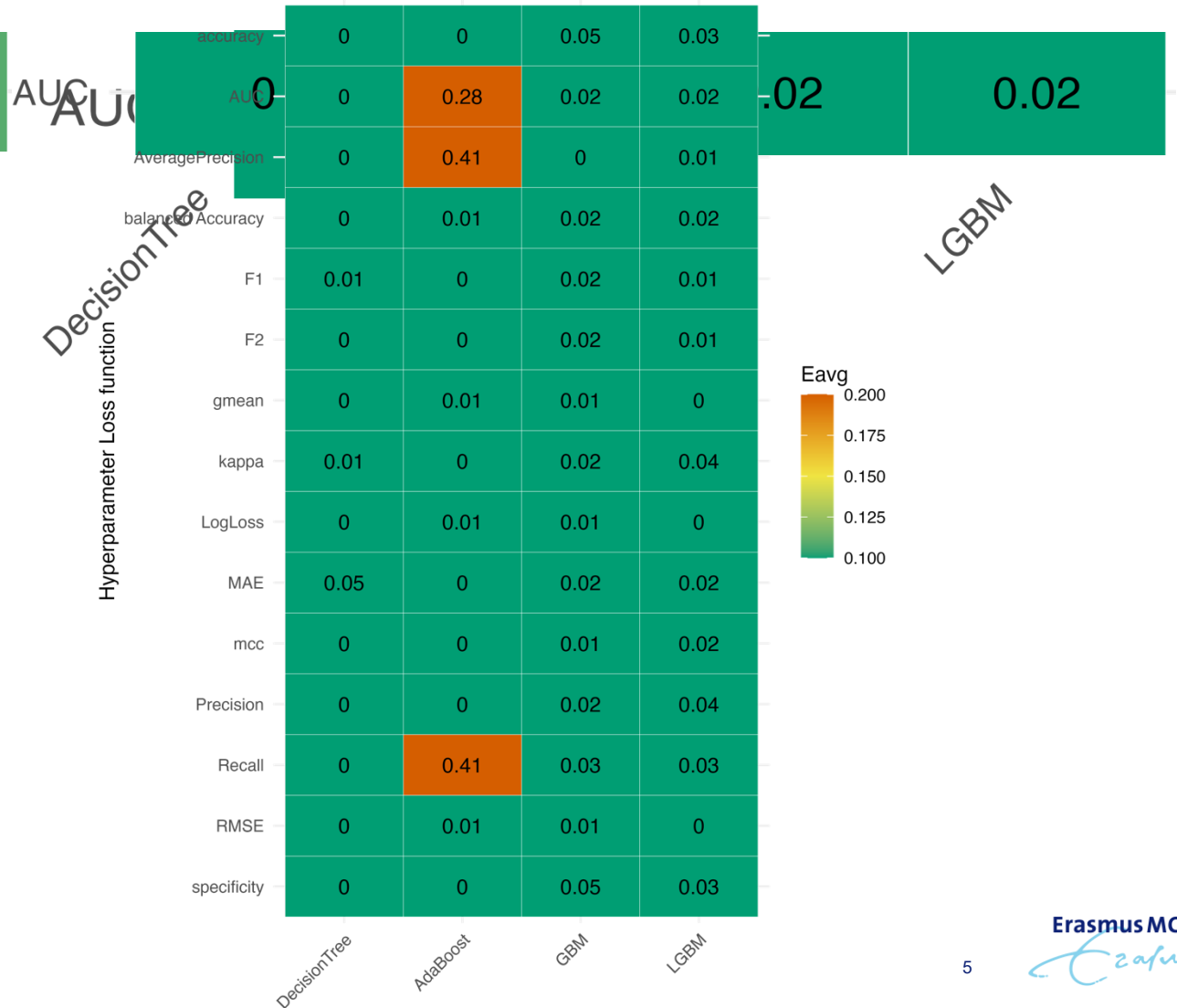


MODELS TRAINED USING DIFFERENT PERFORMANCE METRICS PERFORM SIMILARLY

Discrimination in AUC

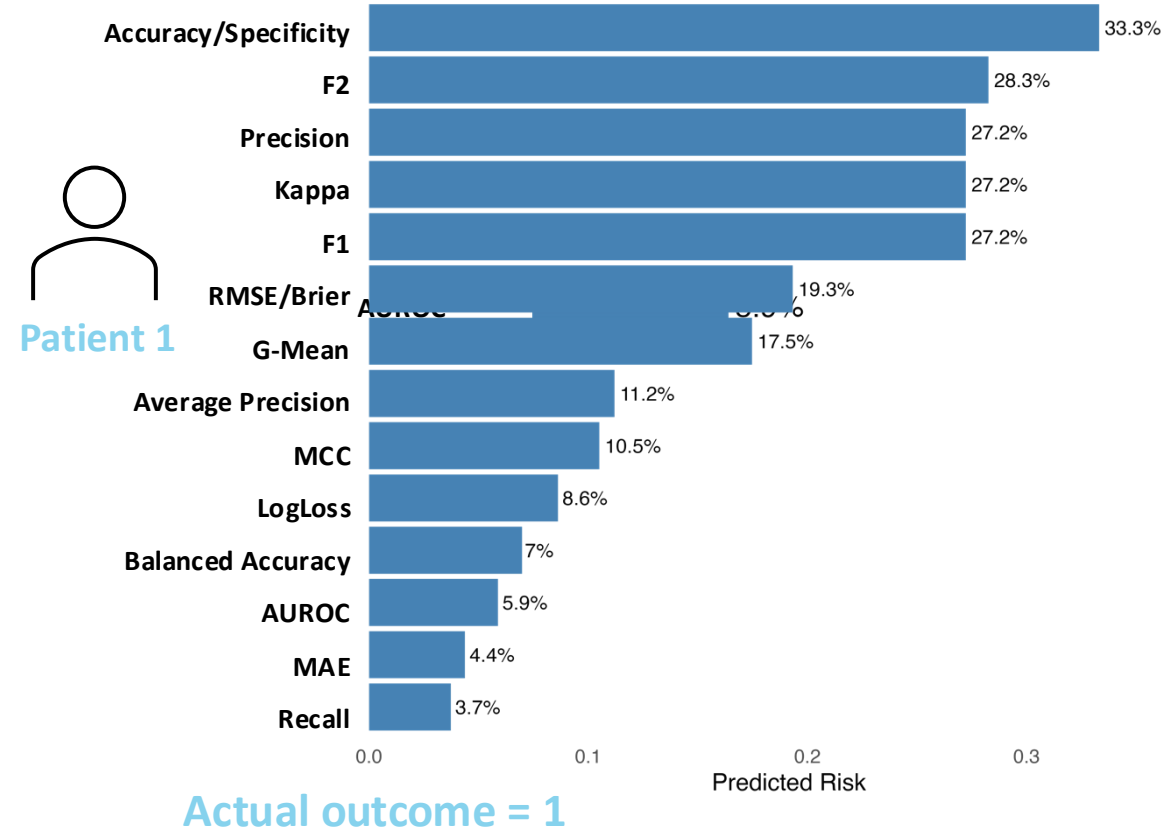
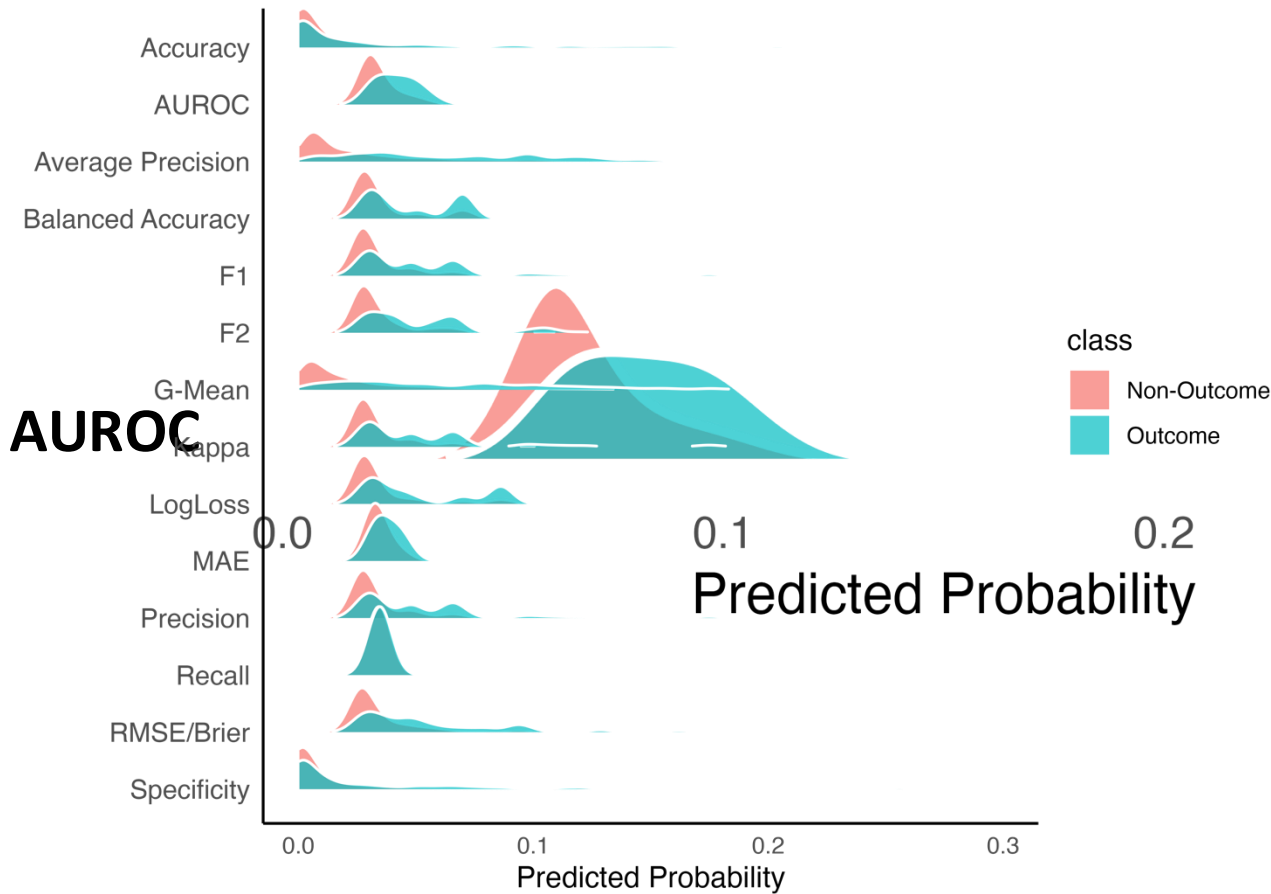


Calibration in Eavg



BUT INDIVIDUAL PREDICTED PROBABILITIES DIFFERED

Individual risk can vary significantly – what model to choose?



Conclusion: the choice of hyperparameter optimization makes a difference.