Pump it Up: Data Mining the Water Table

Seth Chart

Data

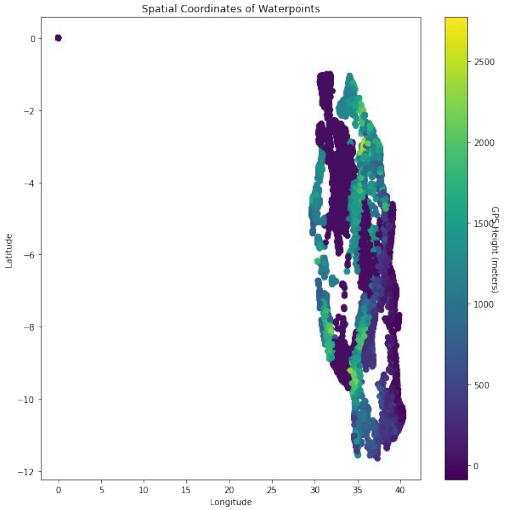
Data was provided by the Pump it Up: Data Mining the Water Table competition on Driven Data:

- https://www.drivendata.org/competitions/7/pump-it-up-data-mining-the-water-table/

Goal

Produce a model to classify the status of waterpoints in Tanzania with the highest possible accuracy score. The possible classes are:

- Functional
- Functional Needs Repair
- Non-Functional



Predictors: Geospatial

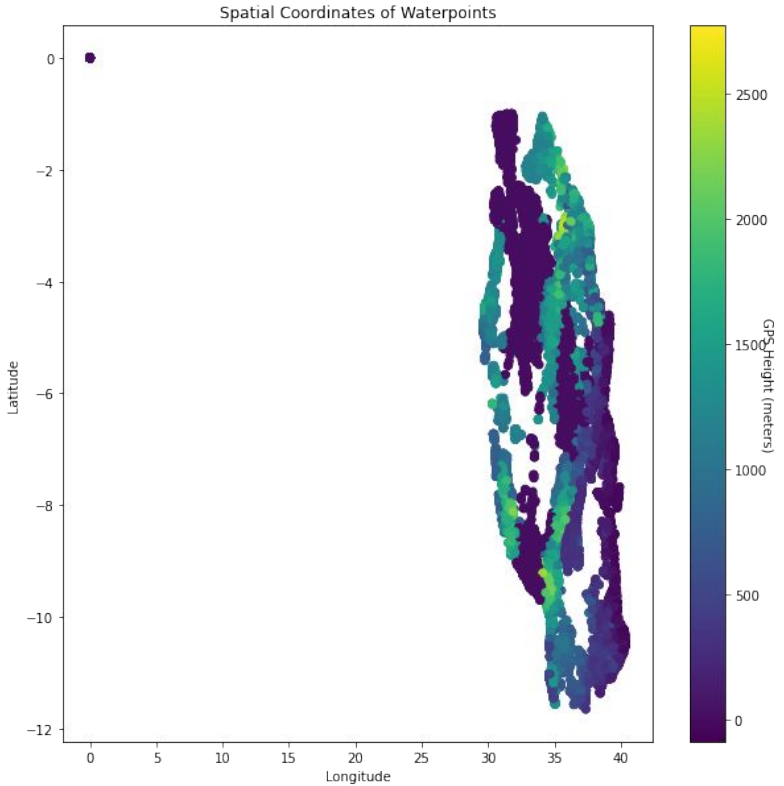
We have Geospatial data in the following features:

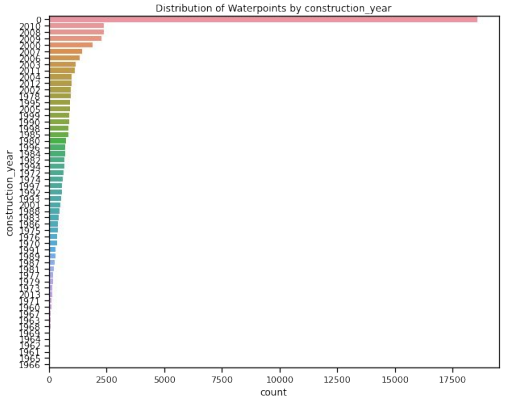
- Longitude
- Latitude
- GPS Height

About 3% of data is missing geospatial coordinates, encoded with zeros.

GPS Height feature can be negative. Possibly incorporates well depth.

Predictors: Geospatial





Predictors: Installation

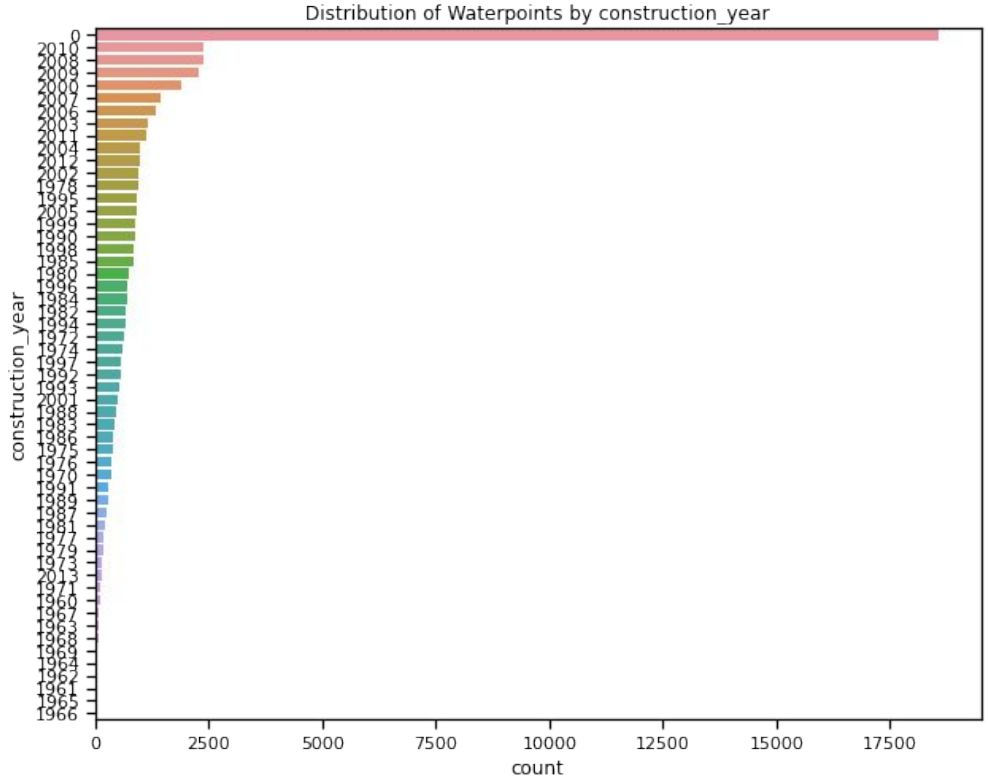
Data about the installation of water points in the features:

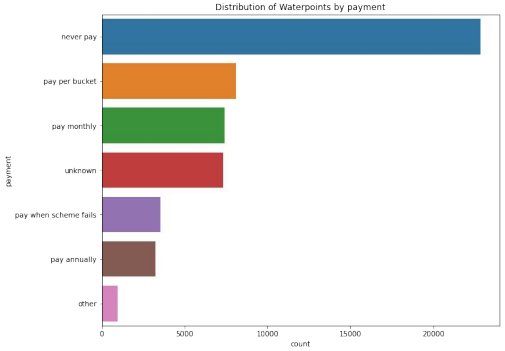
- Construction Year
- Installer
- Funder

Both Installer and Funder have far too many classes to inspect visually.

Construction Year has missing values encoded with zeros.

Predictors: Installation





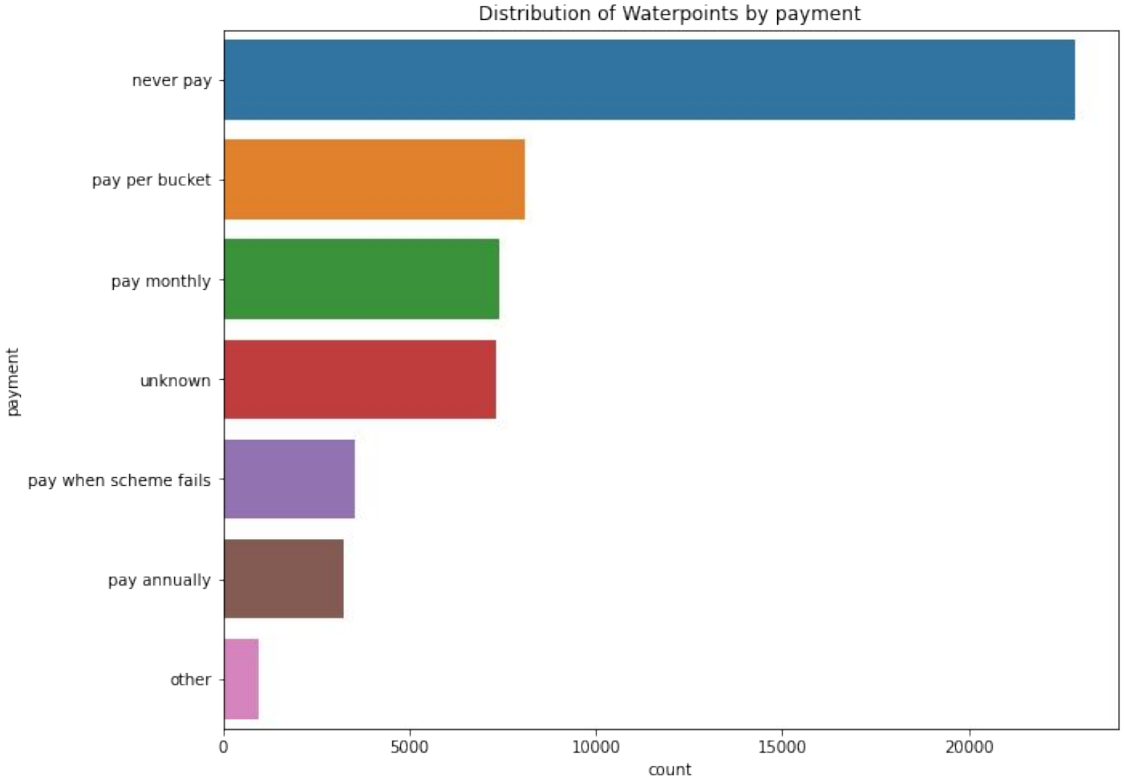
Predictors: Management

Waterpoint management data in the following features:

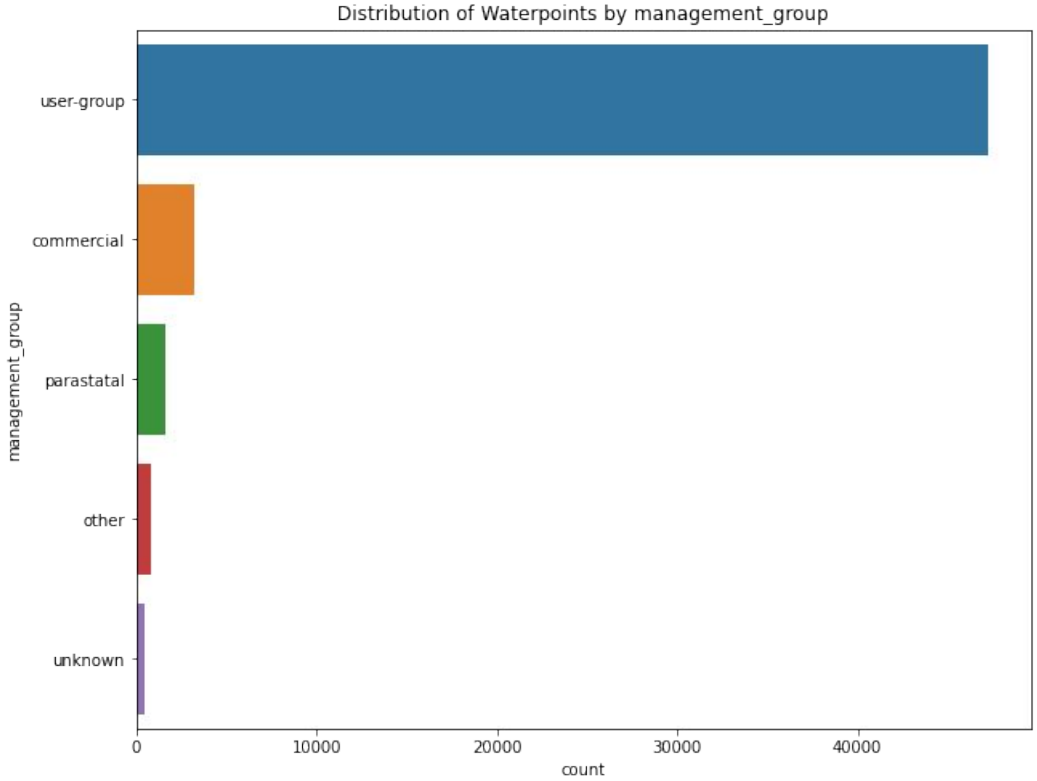
- Scheme Management
- Scheme Name
- Management
- Management Group
- Payment
- Payment Type
- Permit

Scheme Name has too many classes to inspect visually.

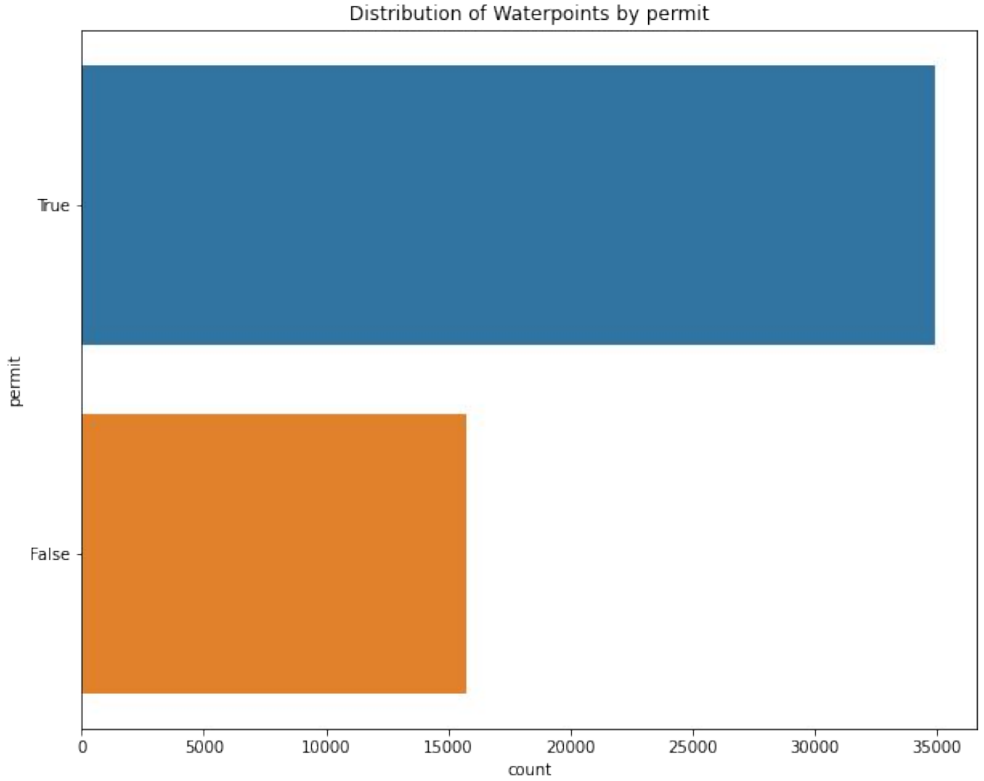
Predictors: Payment

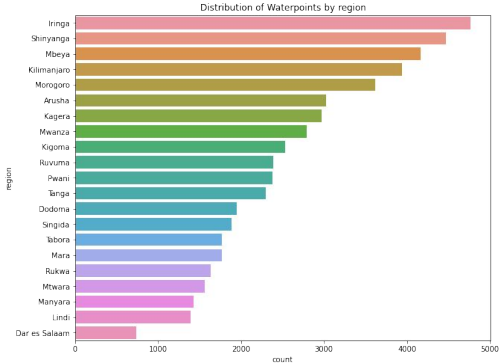


Predictors: Management Group



Predictors: Permit





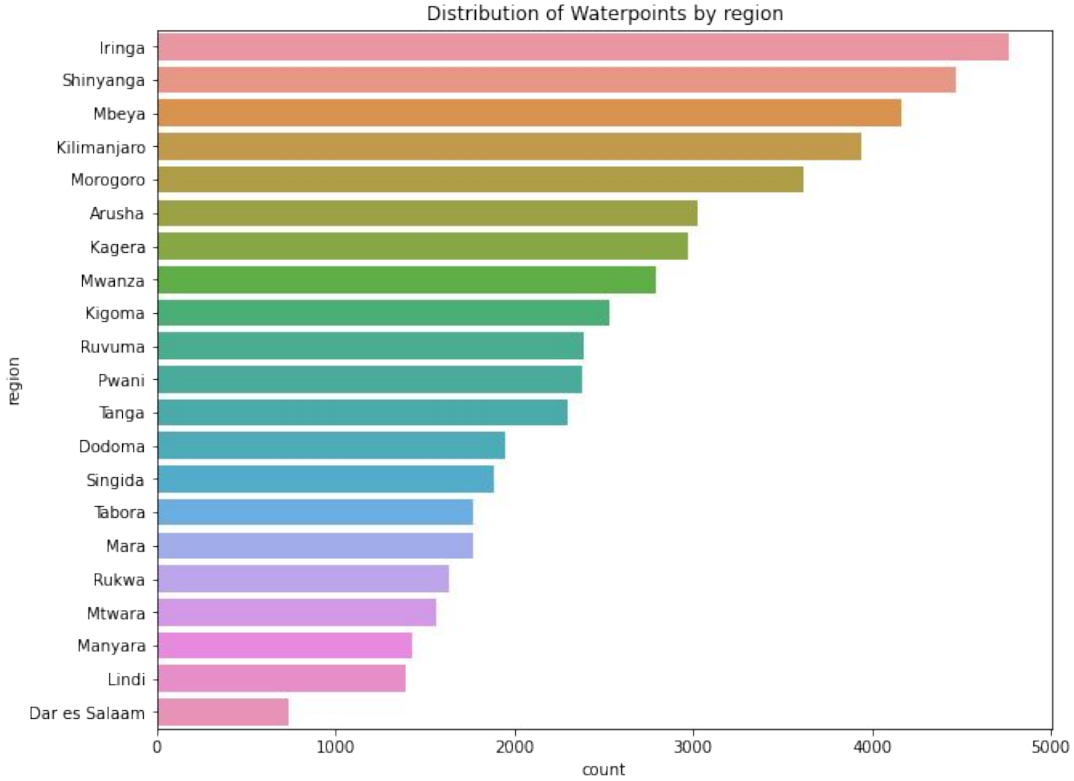
Predictors: Regional

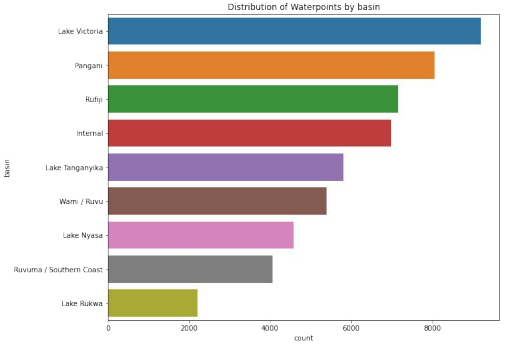
Water points are located all over Tanzania. We have regional data at four levels:

- Region
- District
- Ward
- Sub-Village

All but the top level Region data have too many classes to inspect visually.

Predictors: Region



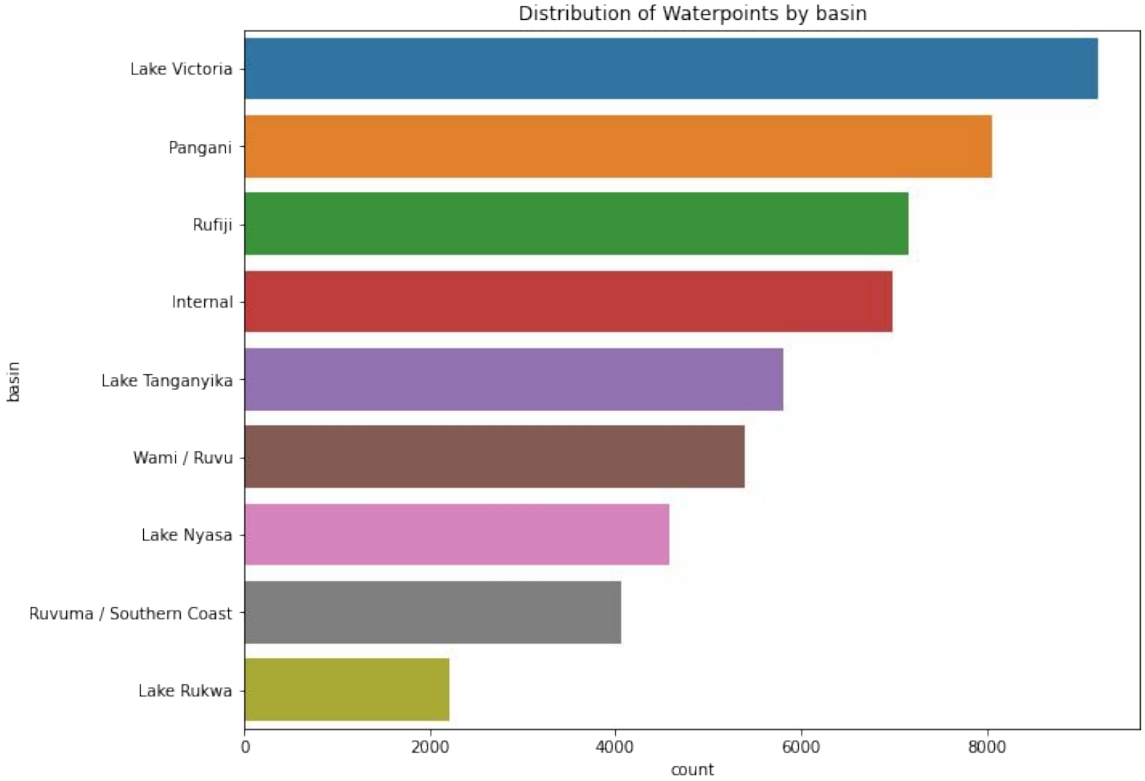


Predictors: Water

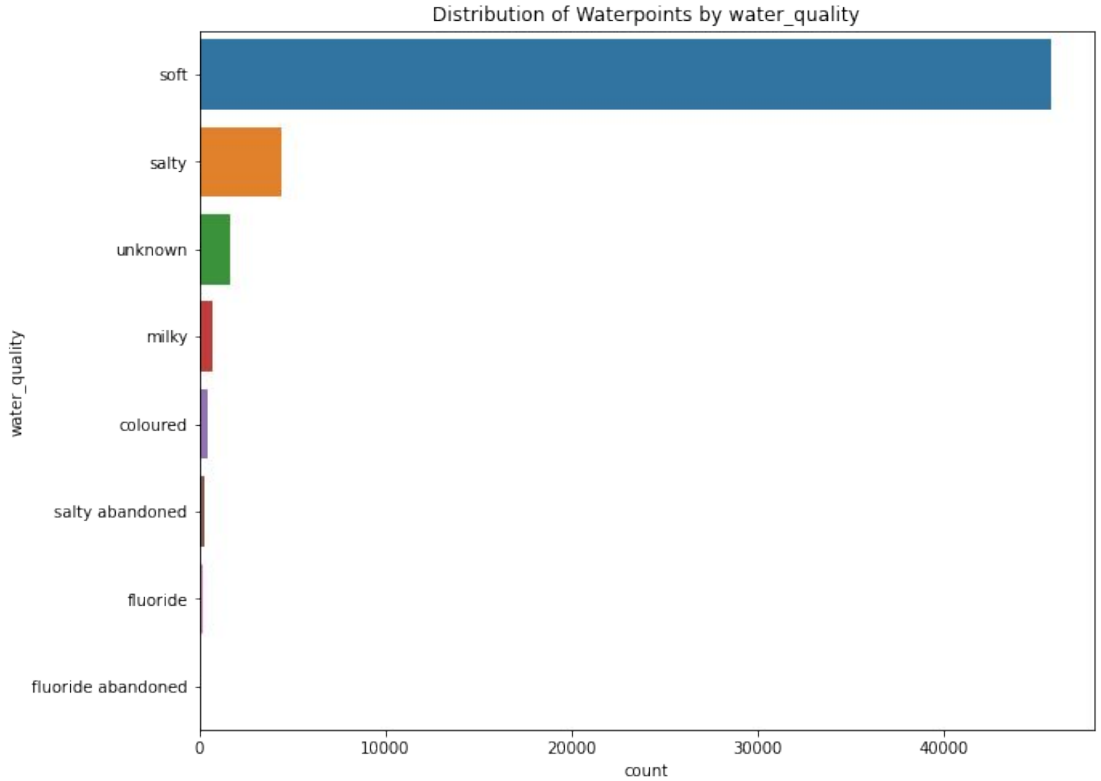
Information about the water accessed by the waterpoint:

- Basin
- Water quality
- Quality Group
- Quantity
- Source
- Source Type
- Source Class

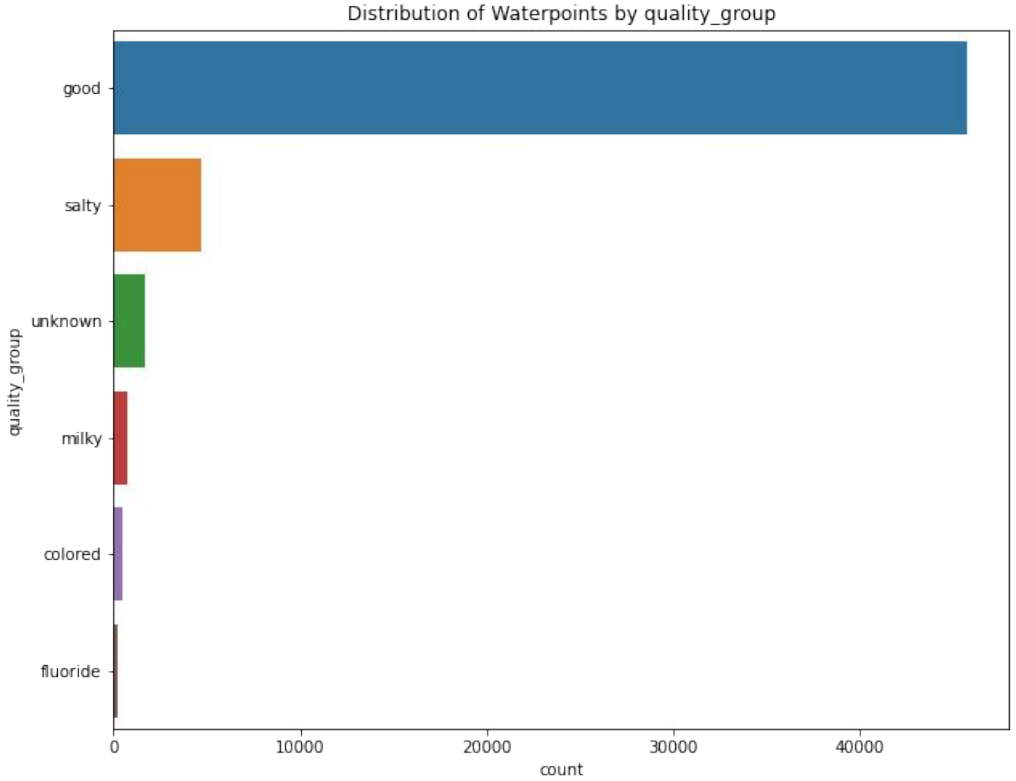
Predictors: Basin



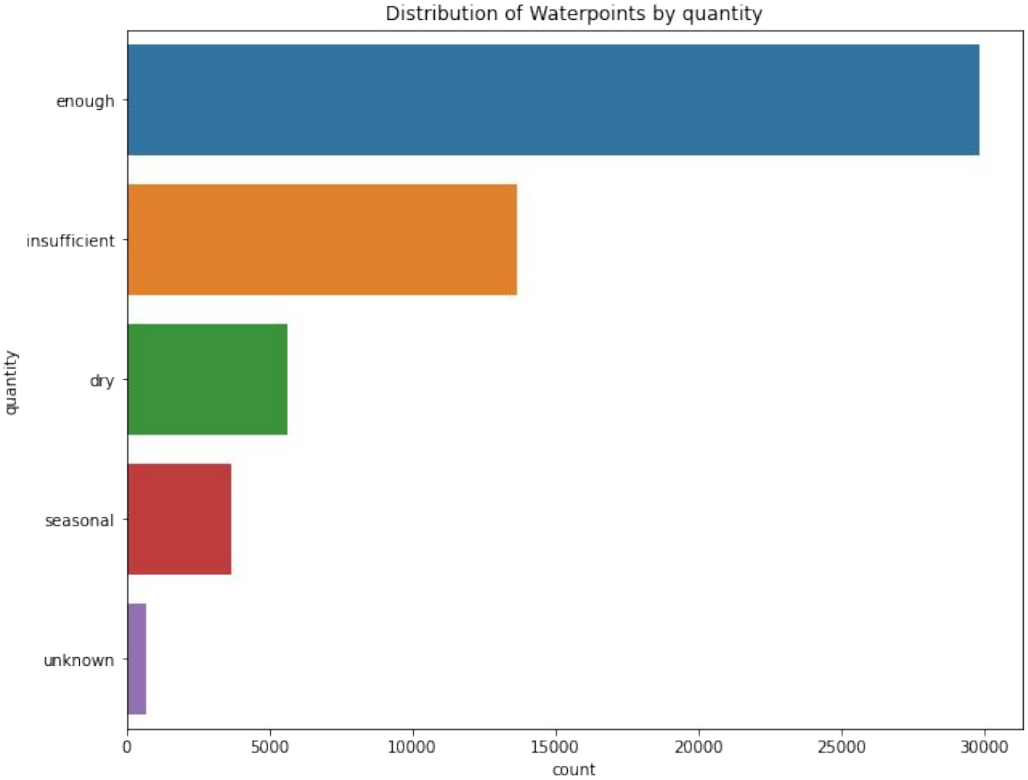
Predictors: Water Quality



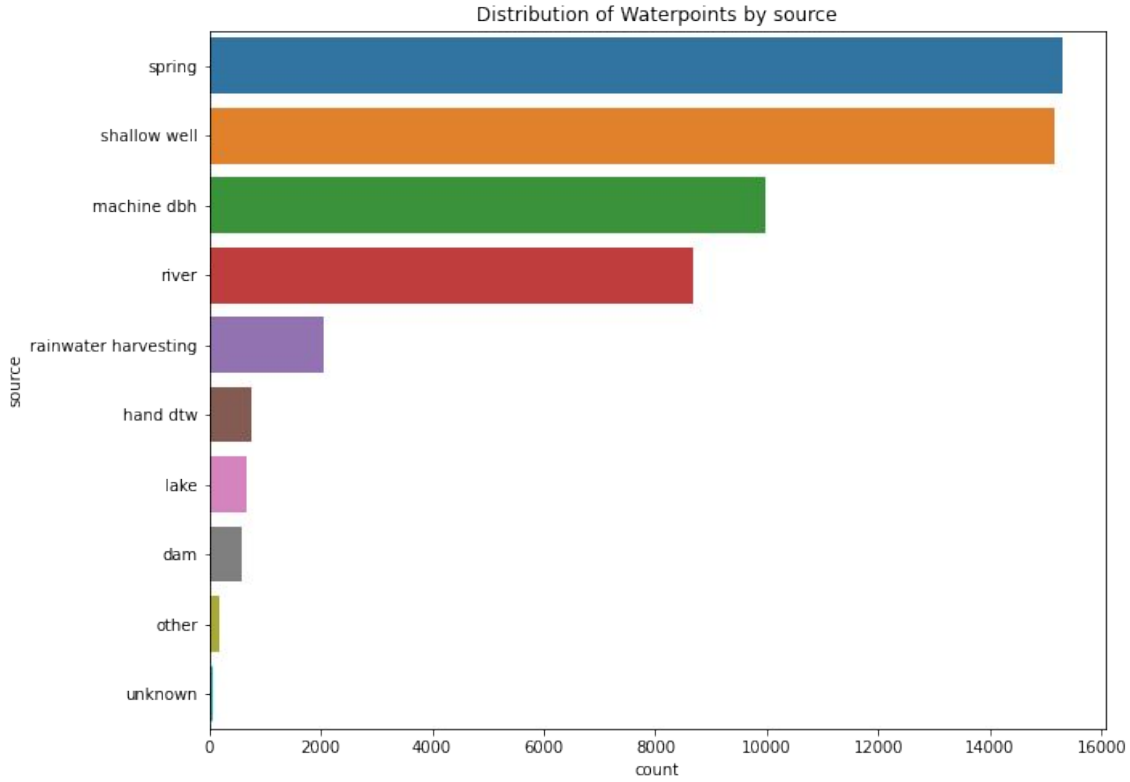
Predictors: Quality Group



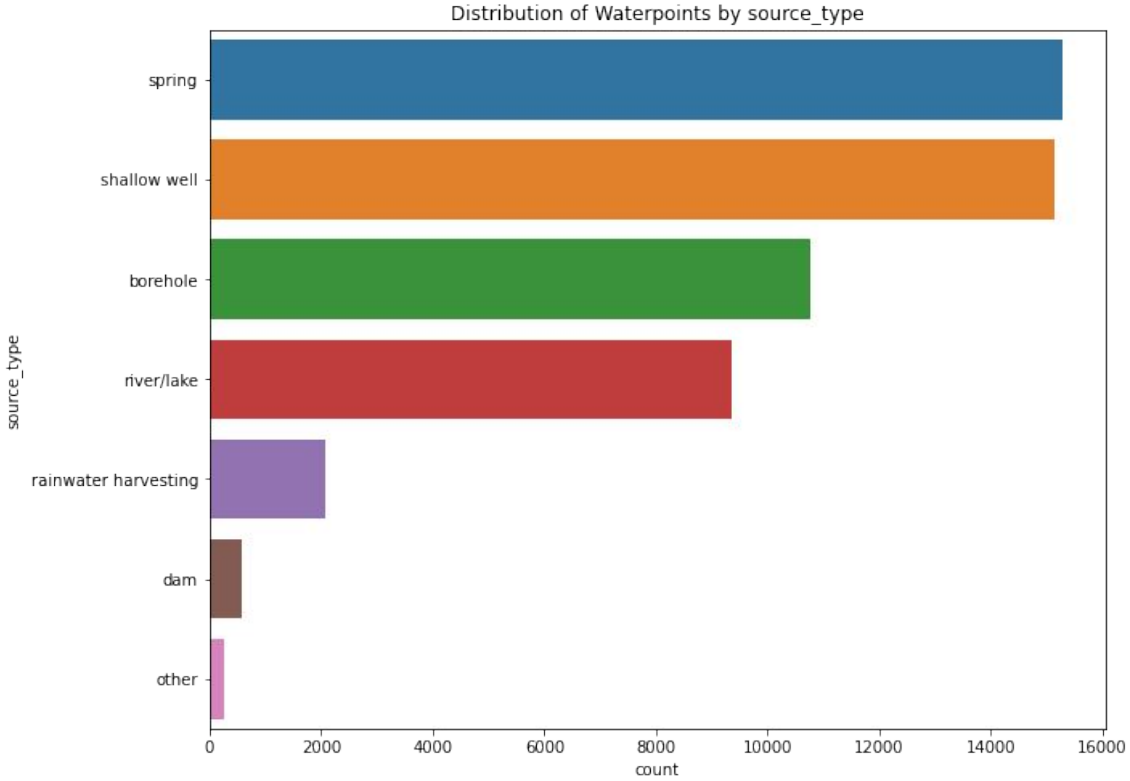
Predictors: Quantity



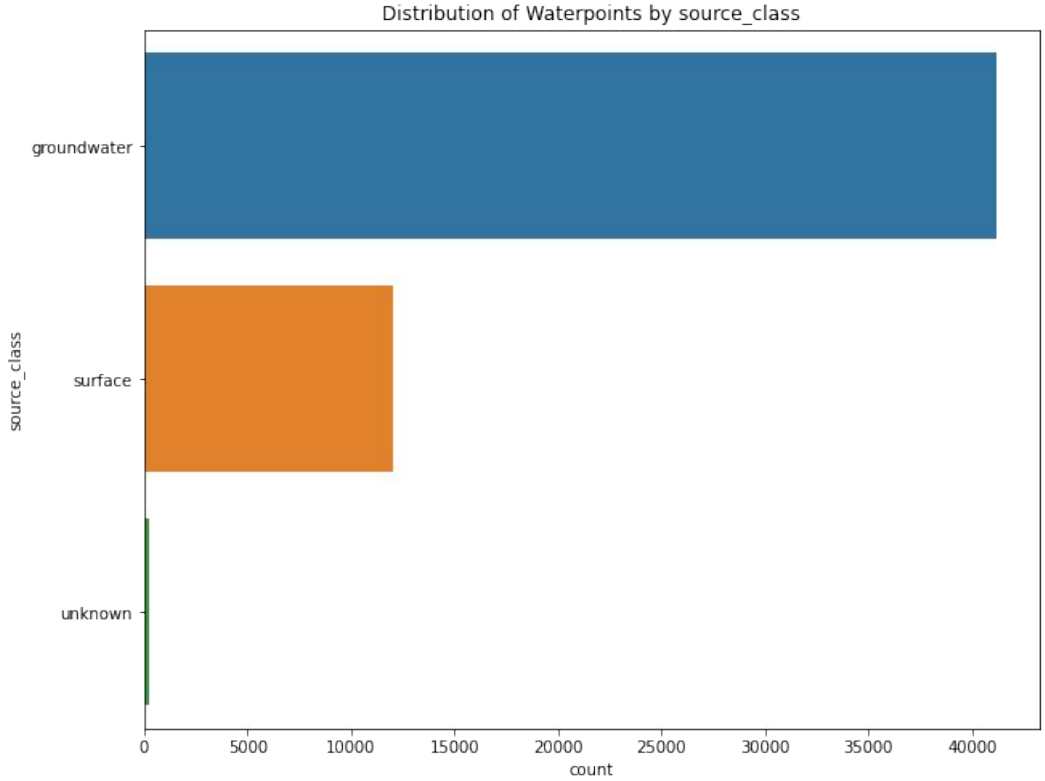
Predictors: Source

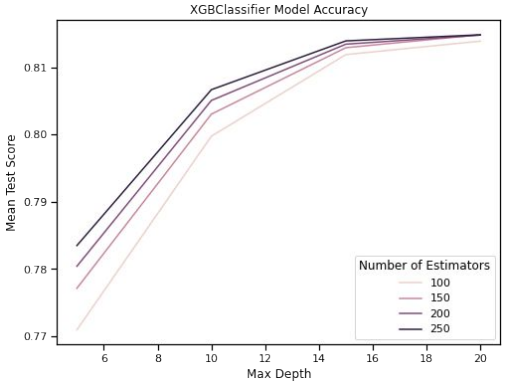


Predictors: Source Type



Predictors: Source Class



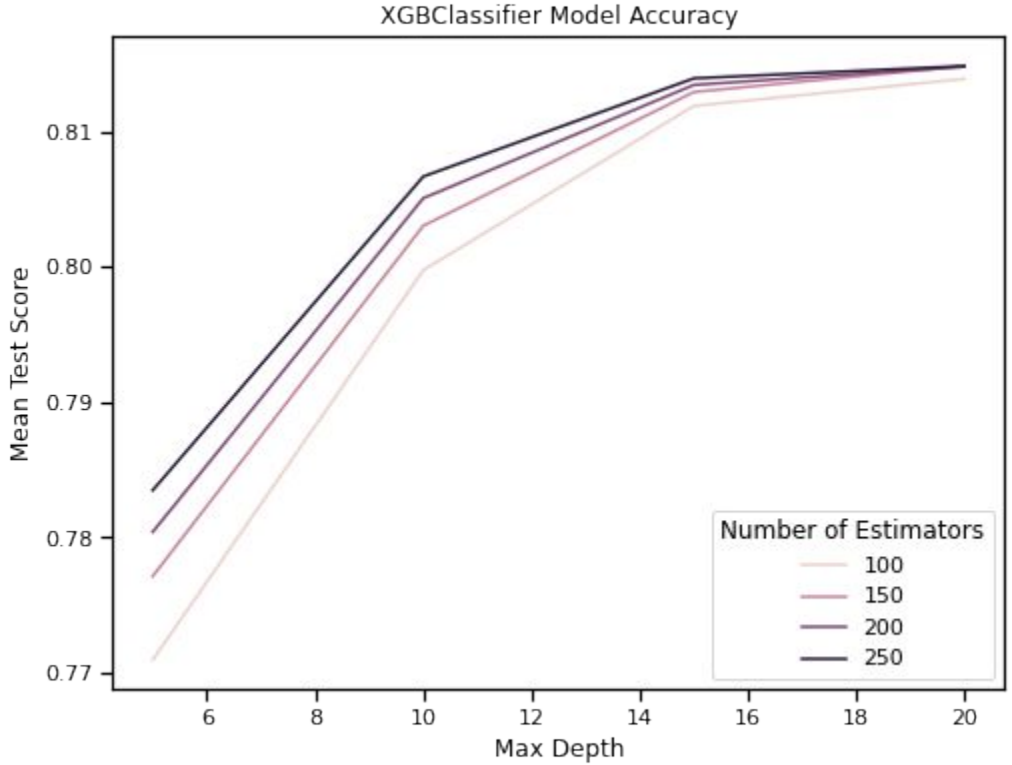


The model

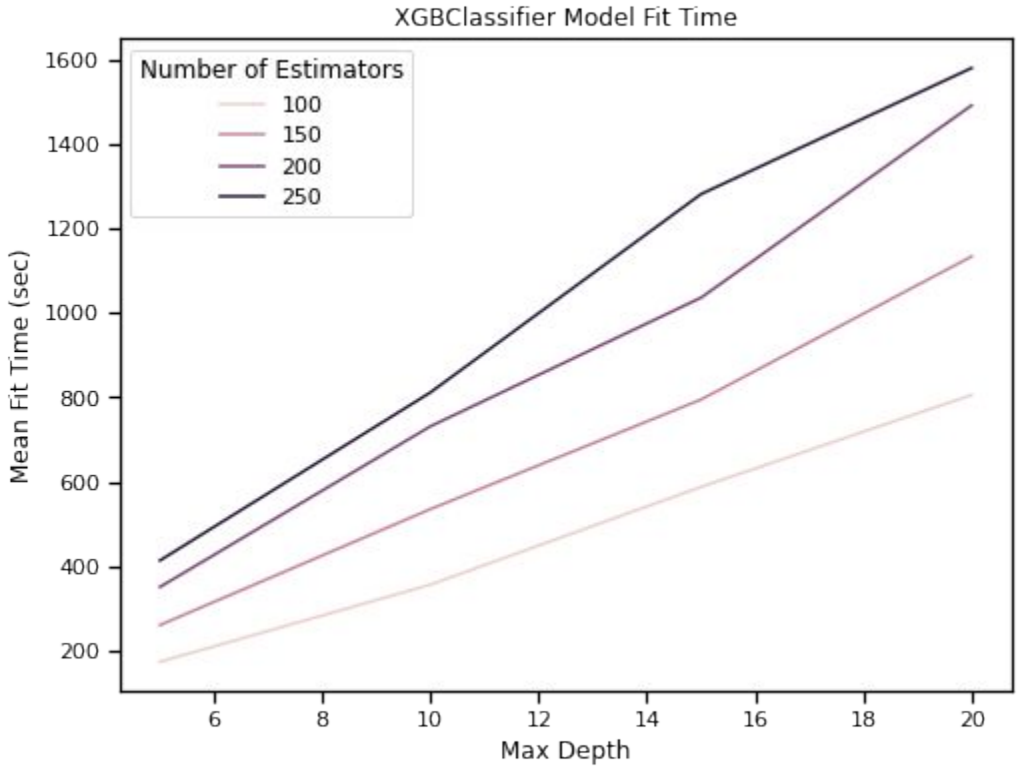
The final model was a XGBoosted random forest classifier with a maximum tree depth of 20 splits and 200 learners.

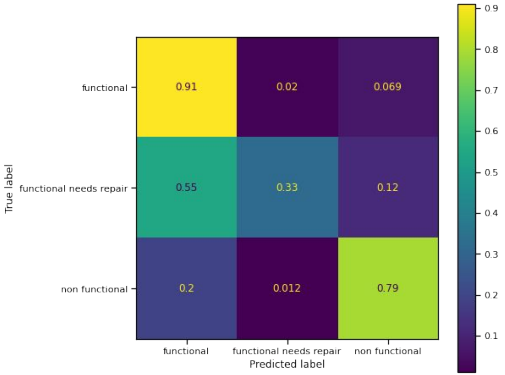
This model was selected using a cross validated gridsearch.

Model Evaluation: Accuracy



Model Evaluation: Fit Time

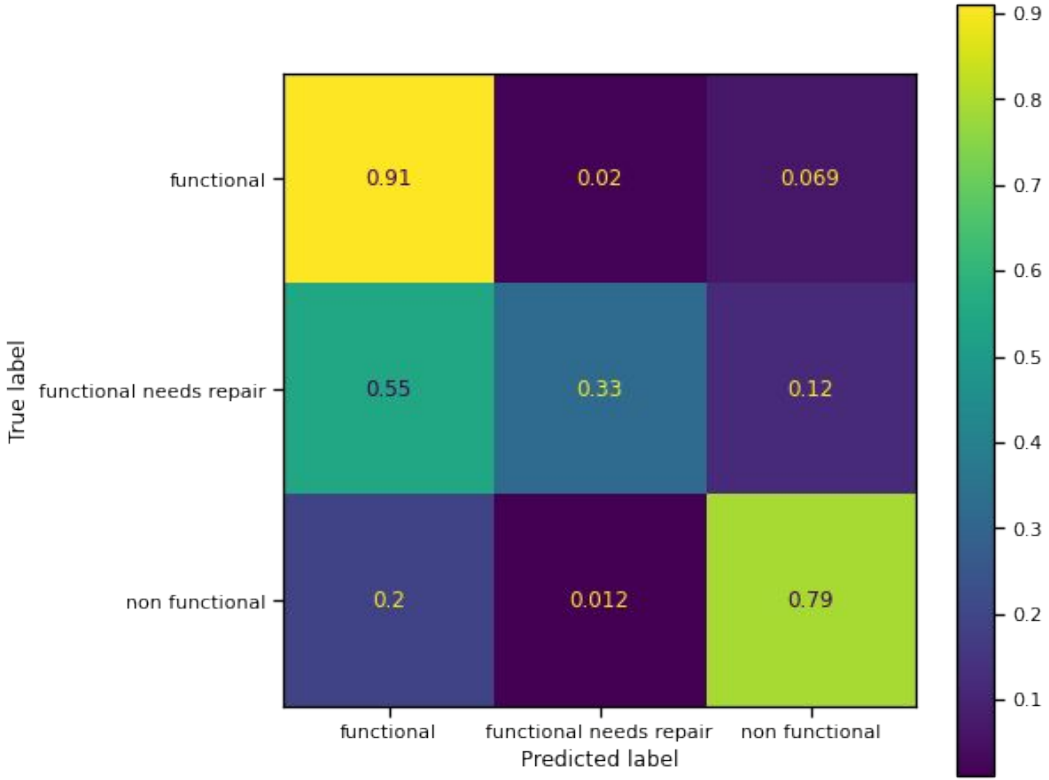




Conclusions

- Accuracy is worst on the 'functional needs repair' group.
- This class is under-represented in the data.
- Most likely, ambiguously defined in comparison to the other classifications.
- My model produced an accuracy score of 0.8227.
- As of the time of writing, the best reported score for the competition is 0.8294 and my model ranks 385 out of 10,307 submissions.

Confusion Matrix



Future Work

The two most promising directions for further work:

- Integrating re-sampling into the pipeline to improve accuracy on the 'functional needs repair' class.
- Implementing hierarchical models or stacked models.

Thank You

https://github.com/sethchart/Pump-it-Up-Data-Mining-the-Water-Table