Uniwersytet
Wrocławski

Online Shoppers Purchasing Intention

Machine Learning, 24/25

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01

Problem statement

Problem statement

Online shoppers purchasing intention:

Predict whether an online shopper, based on a single session, is going to make a purchase or not.

Use case

In the context of a company, our problem provides **valuable insights into customer behaviour**:

- if it was predicted that a specific user will make a purchase from the company’s website, it’s **worth investing** in advertisements or offers for that specific user.
- on the contrary, the company would not be wasting resources on that user.

02

Data

Data

- The dataset consists of information gathered in a period of one year from **12,330 user sessions**, such that each session corresponds to the activity of a unique user.
- Dataset of **17 features** and **one target**, the **Revenue**, which indicates if a person made a purchase or not.
- Of the 12,330 sessions in the dataset, **84.5%** (10,422) are **negative class samples**, so users that did not make a purchase, and the rest **15.5%** (1908) are **positive class samples**, so users that did make a purchase.
- **8** features (including target) in the dataset are **categorical**.

https://archive.ics.uci.edu/dataset/468/online+shoppers+purchasing+intention+dataset

03

Data analysis and pre-processing

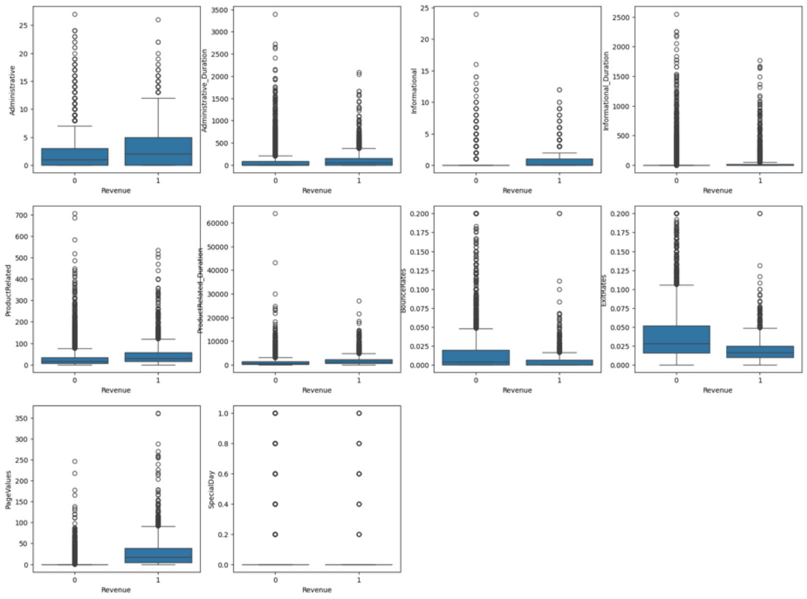
Data analysis

We began by analyzing our data:

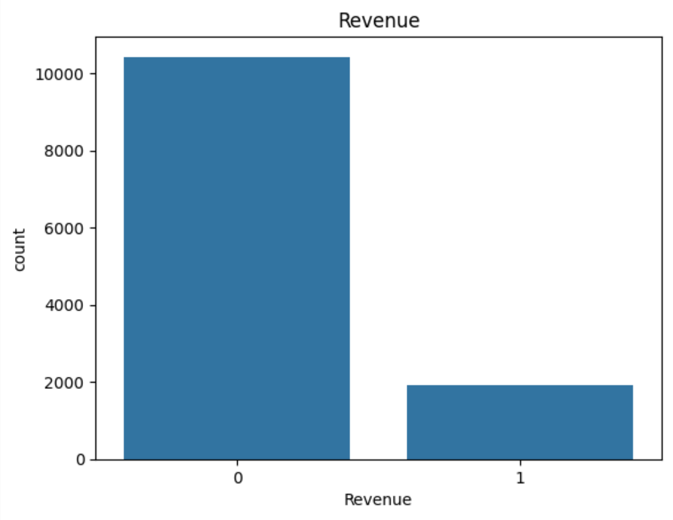
- no **NULL values**;
- **125 duplicated rows**;
- **correlation between the numerical features**;
- **outliers**;
- identified 8 **categorical features**;
- the **target** (“Revenue”) had a very **imbalanced class distribution**.

Data analysis

Outliers of the numerical features.



Class distribution of the target.



Data pre-processing

To handle the information gathered from the analysis and to prepare the data for the models:

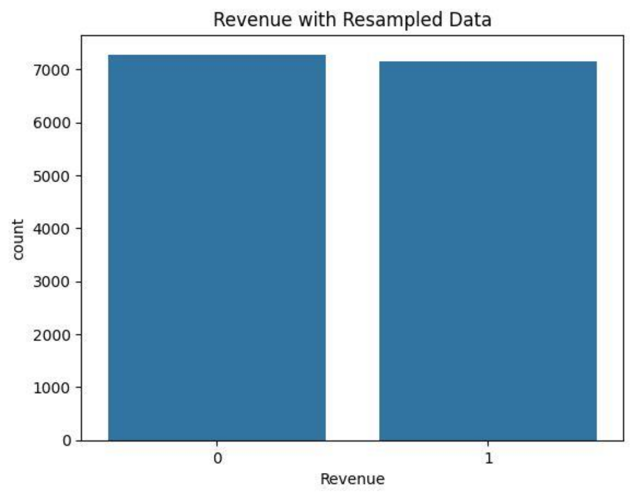
- **removed the duplicate rows**;
- used the **InterquartilleRange (IQR)** to remove the outliers using the 2^{nd} and 98^{th} percentiles;
- used **OneHotEnconder** to transform the categorical features into numerical representations, as a result, the categorical features were expanded into 63 attributes;
- used **MinMaxScaler** to normalize the range of the features' values.
- did **Feature Selection** with **SelectKBest** and **Mutual Information** as the scoring function. This yields the best combination of features, and it is calculated for each individual model.

Handling Class Imbalance

To handle the imbalance of the class distribution of the target:

- created resampled dataset, using **SMOTEENN** which applies **SMOTE** to the minority class and then uses **EditedNearestNeighbours** to "clean" the majority class.

- created **class weights**, that assigns the weights proportional to the inverse of the class frequencies. This is tested as possible parameter value in the models (that use the dataset without resampling).



04

Classification models

Models' setup

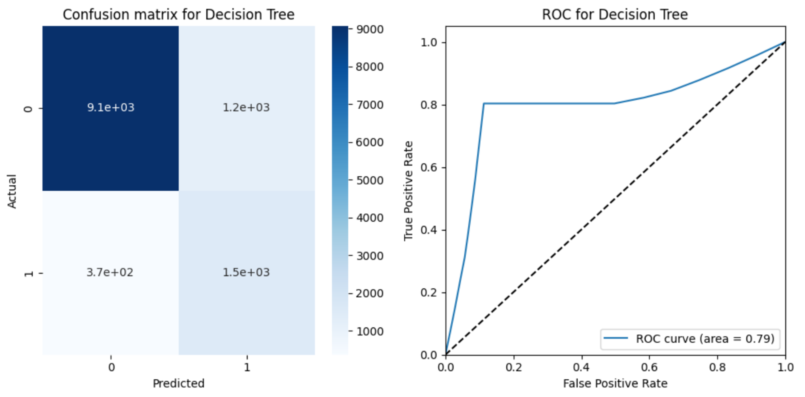
Every model was tested on the original and on the resampled dataset.

1. Performed **hyperparameter tuning** for every model:
   - **RandomizedSearchCV** to find the **best set of values** for the parameters used by the classifier.
   - **GridSearchCV** to obtain the **best parameters** for the classifier. The input for the search is the set obtained from RandomizedSearchCV.
2. Did **feature selection** as previously mentioned.
3. Used **K-Fold Cross-Validation**:
   - By performing the data split many times, we ensure that the **model's performance is evaluated in a robust way**, increasing the generalizability and reducing the chance of overfitting.

Decision Tree

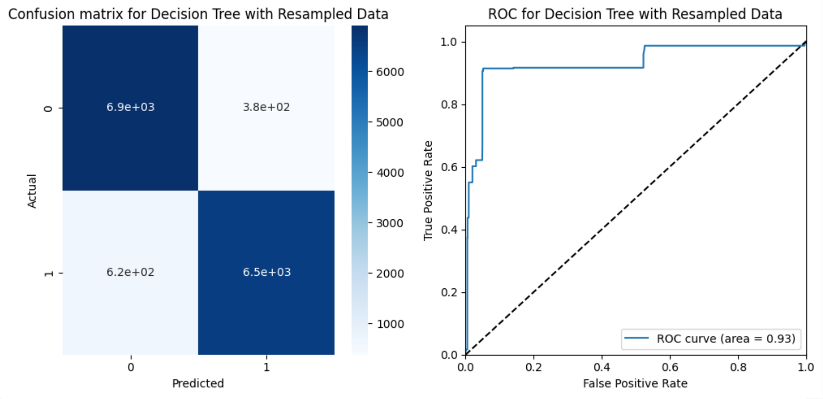
Normal data

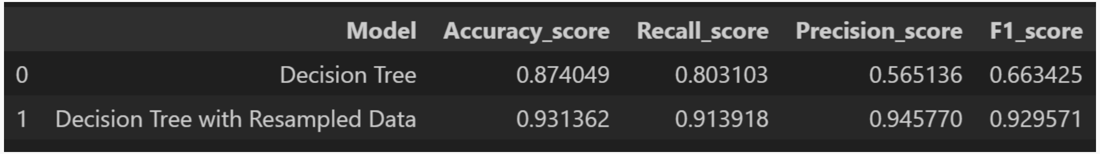
2 features were selected by SelectKBest.



Resampled data

11 features were selected by SelectKBest.



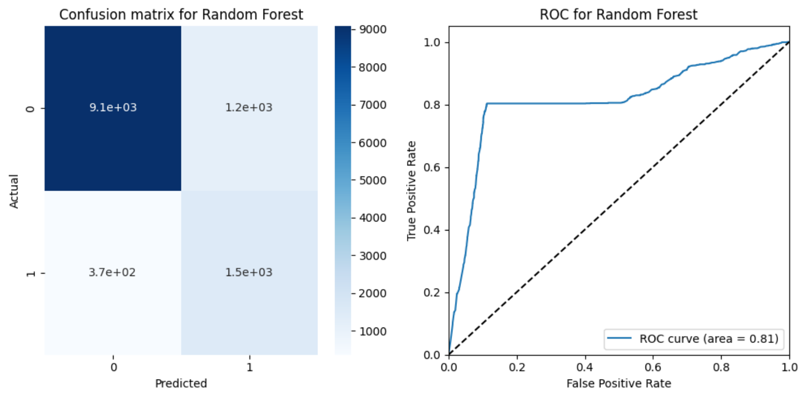


	Model	Accuracy_score	Recall_score	Precision_score	F1_score
0	Decision Tree	0.874049	0.803103	0.565136	0.663425
1	Decision Tree with Resampled Data	0.931362	0.913918	0.945770	0.929571

Random Forest

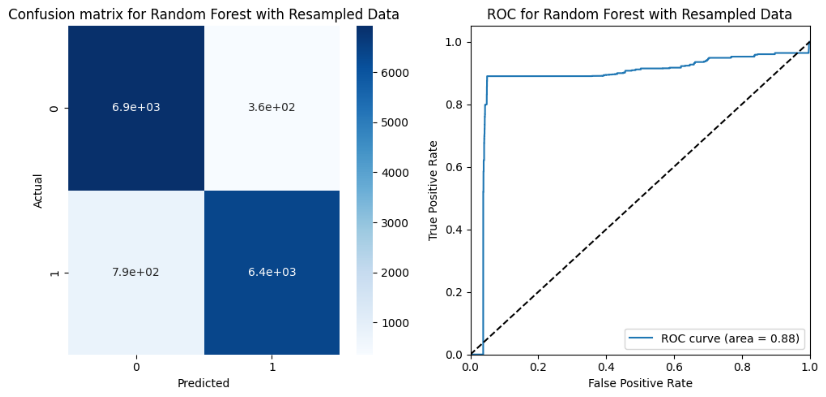
Normal data

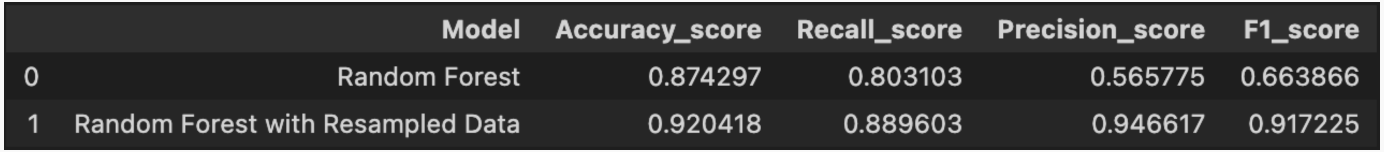
54 features were selected by SelectKBest.



Resampled data

3 features were selected by SelectKBest.



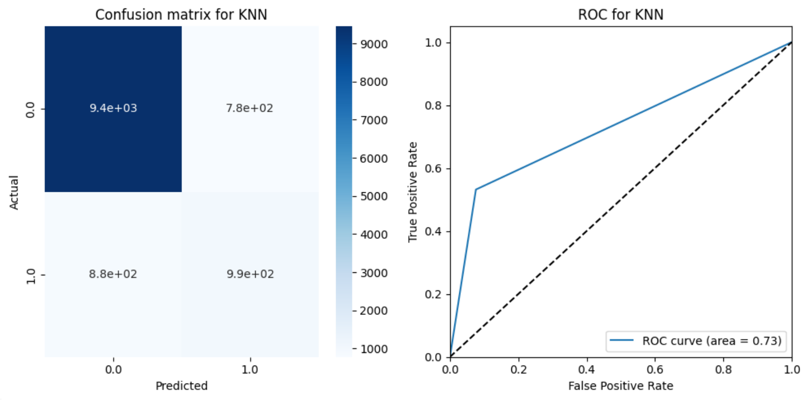


	Model	Accuracy_score	Recall_score	Precision_score	F1_score
0	Random Forest	0.874297	0.803103	0.565775	0.663866
1	Random Forest with Resampled Data	0.920418	0.889603	0.946617	0.917225

K-Nearest Neighbours

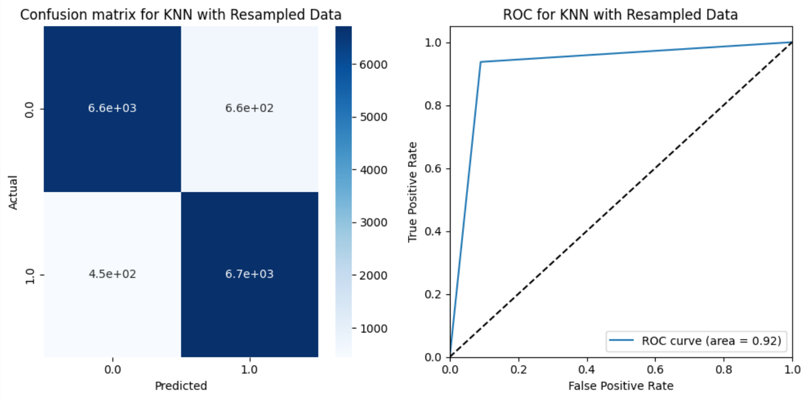
Normal scaled data

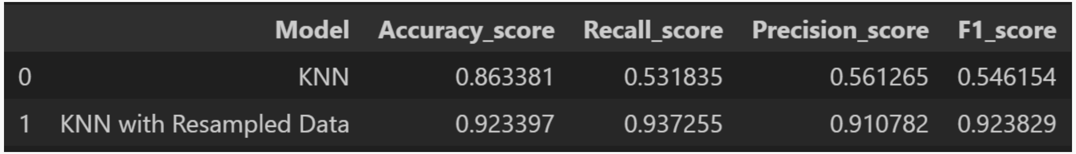
5 features were selected by SelectKBest.



Resampled scaled data

12 features were selected by SelectKBest.



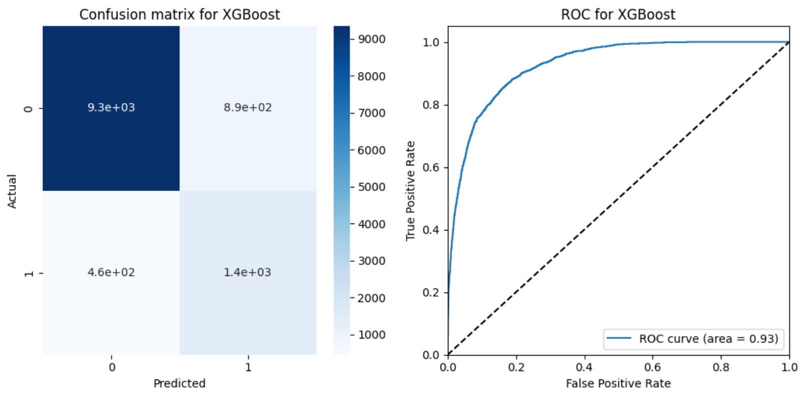


	Model	Accuracy_score	Recall_score	Precision_score	F1_score
0	KNN	0.863381	0.531835	0.561265	0.546154
1	KNN with Resampled Data	0.923397	0.937255	0.910782	0.923829

XGBoost

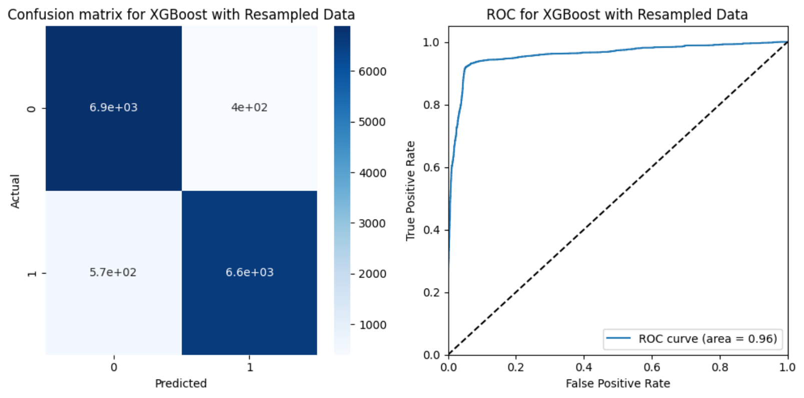
Normal data

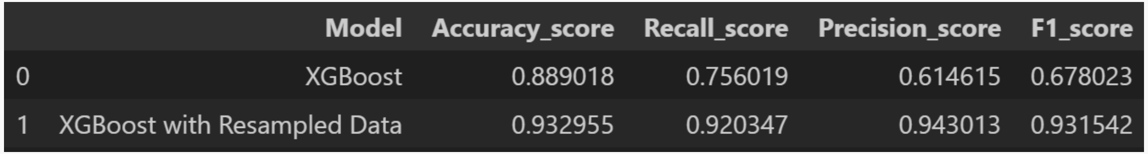
48 features were selected by SelectKBest.



Resampled data

11 features were selected by SelectKBest.

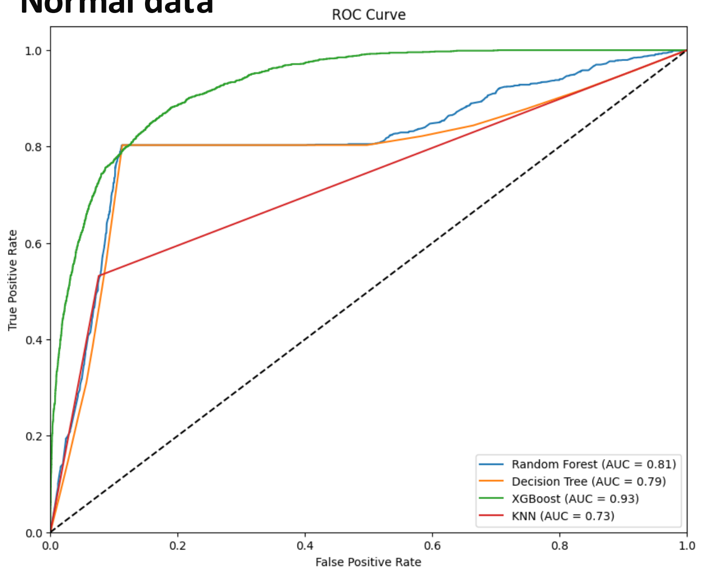


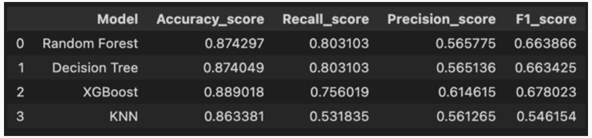


	Model	Accuracy_score	Recall_score	Precision_score	F1_score
0	XGBoost	0.889018	0.756019	0.614615	0.678023
1	XGBoost with Resampled Data	0.932955	0.920347	0.943013	0.931542

Comparing all models

Normal data





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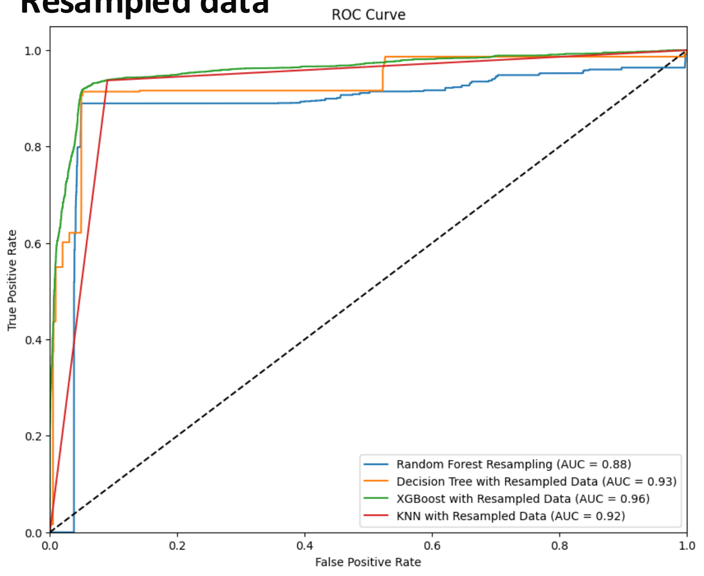
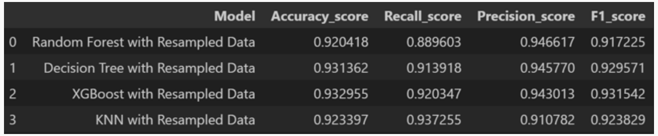
Resampled data





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GitHub repository:

https://github.com/marianaosiecka/ML_project_uwr_2025.git

References

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Thank you for your attention!

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