



ROBERT v 1.0.2 2023/07/15 12:10:37

Citation: ROBERT v 1.0.2, Dalmau, D.; Alegre-Requena, J. V., 2023. <https://github.com/jvalegre/robert>

Command line used in ROBERT: `robert --ignore [Name] --names Name --y Target_values --csv_name Robert_example.csv`

Total execution time: 132.04 seconds



CURATE

o Starting data curation with the CURATE module

o Database Robert_example.csv loaded successfully, including:

- 37 datapoints
- 11 accepted descriptors
- 1 ignored descriptors
- 0 discarded descriptors

o Analyzing categorical variables

A total of 1 categorical variables were converted using the onehot mode in the categorical option

Initial descriptors:

- x4

Generated descriptors:

- Csub-Csub
- Csub-H
- Csub-O
- H-O

o Duplication filters activated

Excluded datapoints:

- No datapoints were removed

o Correlation filter activated with these thresholds: $\text{thres_x} = 0.9$, $\text{thres_y} = 0.001$

Excluded descriptors:

- x3: $R^2 = 1.0$ with x1
- x1: $R^2 = 0.96$ with x6

o 14 columns remaining after applying duplicate and correlation filters:

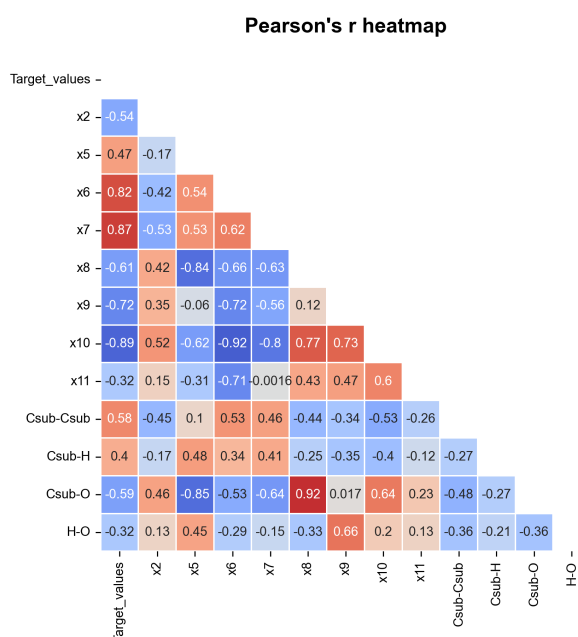
- Name
- Target_values
- x2
- x5
- x6
- x7
- x8
- x9
- x10
- x11
- Csub-Csub

- Csub-H
- Csub-O
- H-O

- o The Pearson heatmap was stored in CURATE/Pearson_heatmap.png.
- o The curated database was stored in CURATE/Robert_example_CURATE.csv.

Time CURATE: 0.57 seconds

----- Images generated by the CURATE module -----

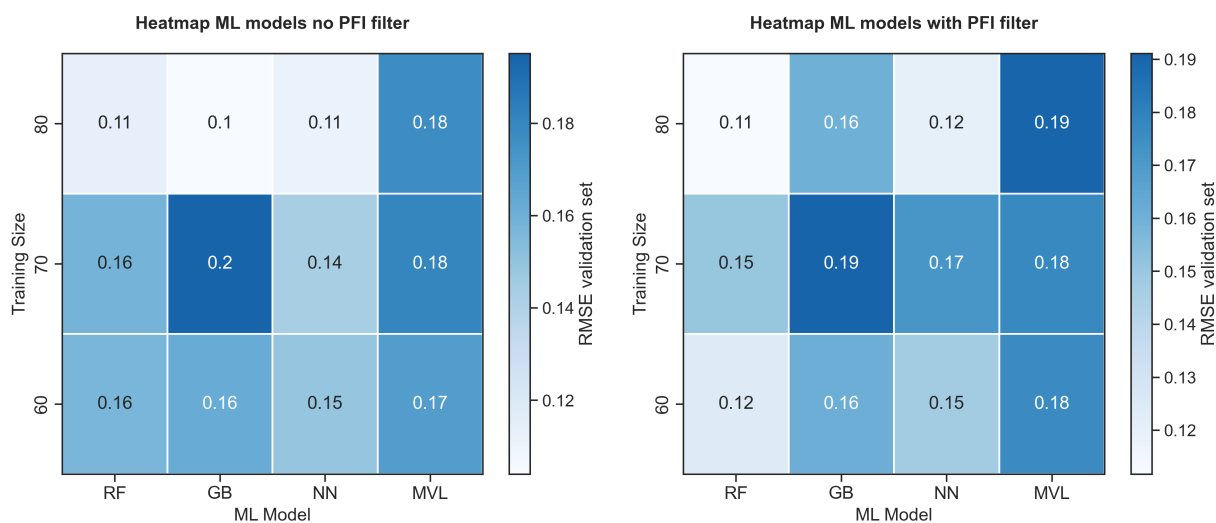


GENERATE

- o Starting generation of ML models with the GENERATE module
- o Database Robert_example_CURATE.csv loaded successfully, including:
 - 37 datapoints
 - 12 accepted descriptors
 - 1 ignored descriptors
 - 0 discarded descriptors
- x WARNING! The database contains 37 datapoints, the 90% training size will be excluded (too few validation points to reach a reliable result). You can include this size using "--filter_train False".
- o Starting heatmap scan with 4 ML models (['RF', 'GB', 'NN', 'MVL']) and 3 training sizes ([60, 70, 80]).
 - 72 models were tested, for more information check the GENERATE_data.dat file in the GENERATE folder
- o Heatmap ML models no PFI filter succesfully created in GENERATE/Raw_data
- o Heatmap ML models with PFI filter succesfully created in GENERATE/Raw_data

Time GENERATE: 122.51 seconds

----- Images generated by the GENERATE module -----



- o Starting tests to verify the prediction ability of the ML models with the VERIFY module

----- Starting model with all variables (No PFI) -----

- o ML model GB_80 (with no PFI filter) and Xy database were loaded, including:
 - Target value: Target_values
 - Model: GB
 - Descriptors: ['x2', 'x5', 'x6', 'x7', 'x8', 'x9', 'x10', 'x11', 'Csub-Csub', 'Csub-H', 'Csub-O', 'H-O']
 - Training points: 29
 - Validation points: 8
 - o VERIFY donut plots saved in VERIFY/VERIFY_tests_GB_80_No_PFI.png
 - o VERIFY test values saved in VERIFY/VERIFY_tests_GB_80_No_PFI.dat
- Results of the VERIFY tests:
- Original score (train set in CV): RMSE = 0.031, +- 20% threshold (thres_test option):
- 5-fold CV: NOT DETERMINED, data splitting was done with KN. CV result: RMSE = 0.22
- Original score (validation set): RMSE = 0.1, +- 20% threshold (thres_test option):
- o y_mean: PASSED, RMSE = 0.66 is higher than the threshold (0.12)
 - o y_shuffle: PASSED, RMSE = 0.8 is higher than the threshold (0.12)
 - o onehot: PASSED, RMSE = 0.2 is higher than the threshold (0.12)

----- Starting model with PFI filter (only important descriptors used) -----

- o ML model RF_80_PFI (with PFI filter) and Xy database were loaded, including:
 - Target value: Target_values
 - Model: RF
 - Descriptors: ['x6', 'x7', 'x9', 'x10']
 - Training points: 29
 - Validation points: 8

- o VERIFY donut plots saved in VERIFY/VERIFY_tests_RF_80_PFI.png
- o VERIFY test values saved in VERIFY/VERIFY_tests_RF_80_PFI.dat

Results of the VERIFY tests:

Original score (train set in CV): RMSE = 0.11, +- 20% threshold (thres_test option):

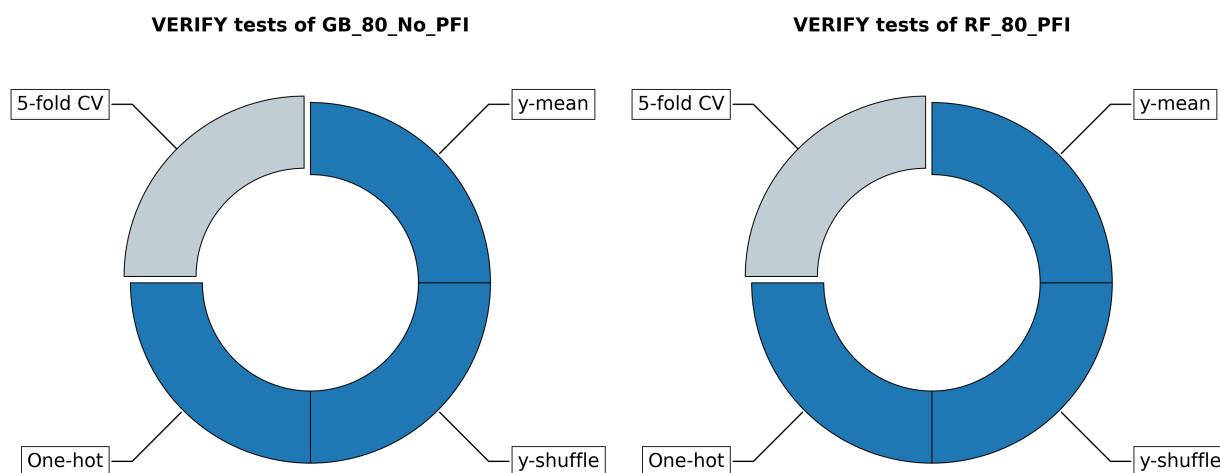
- 5-fold CV: NOT DETERMINED, data splitting was done with KN. CV result: RMSE = 0.22

Original score (validation set): RMSE = 0.11, +- 20% threshold (thres_test option):

- o y_mean: PASSED, RMSE = 0.66 is higher than the threshold (0.13)
- o y_shuffle: PASSED, RMSE = 0.88 is higher than the threshold (0.13)
- o onehot: PASSED, RMSE = 0.21 is higher than the threshold (0.13)

Time VERIFY: 1.98 seconds

----- Images generated by the VERIFY module -----



PREDICT

- o Representation of predictions and analysis of ML models with the PREDICT module

----- Starting model with all variables (No PFI) -----

- o ML model GB_80 (with no PFI filter) and Xy database were loaded, including:
 - Target value: Target_values
 - Model: GB
 - Descriptors: ['x2', 'x5', 'x6', 'x7', 'x8', 'x9', 'x10', 'x11', 'Csub-Csub', 'Csub-H', 'Csub-O', 'H-O']
 - Training points: 29
 - Validation points: 8
 - Train set with predicted results: GB_80_train_No_PFI.csv
 - Validation set with predicted results: GB_80_valid_No_PFI.csv
- o Saving graphs and CSV databases in:
 - Graph in: PREDICT/Results_GB_80_No_PFI.png
- o Results saved in PREDICT/Results_GB_80_No_PFI.dat:
 - Points Train:Validation = 29:8
 - Proportion Train:Validation = 78:22
 - Number of descriptors = 12

- Proportion points:descriptors = 37:12
- Train : R2 = 1.0, MAE = 0.025, RMSE = 0.031
- Validation : R2 = 0.98, MAE = 0.077, RMSE = 0.1

- o SHAP plot saved in PREDICT/SHAP_GB_80_No_PFI.png
- o SHAP values saved in PREDICT/SHAP_GB_80_No_PFI.dat:

- x6 = min: -0.33, max: 0.18
- x10 = min: -0.39, max: 0.17
- x5 = min: -0.1, max: 0.16
- x2 = min: -0.067, max: 0.1
- x7 = min: -0.094, max: 0.082
- x9 = min: -0.13, max: 0.051
- Csub-Csub = min: -0.056, max: 0.03
- Csub-O = min: -0.06, max: 0.019
- x11 = min: -0.043, max: 0.017
- x8 = min: -0.072, max: 0.017
- Csub-H = min: -0.019, max: 0.012
- H-O = min: 0.0, max: 0.0

- o PFI plot saved in PREDICT/PFI_GB_80_No_PFI.png
- o PFI values saved in PREDICT/PFI_GB_80_No_PFI.dat:

Original score (from model.score, R2) = 0.98

- x10 = 0.17 +- 0.061
- x6 = 0.12 +- 0.053
- x5 = 0.038 +- 0.029
- x7 = 0.026 +- 0.019
- x9 = 0.019 +- 0.01
- x2 = 0.017 +- 0.0096
- Csub-H = 0.0067 +- 0.0055
- x11 = 0.0054 +- 0.0058
- Csub-Csub = 0.0032 +- 0.0062
- x8 = 0.0025 +- 0.0023

- o Outliers plot saved in PREDICT/Outliers_GB_80_No_PFI.png
- o Outlier values saved in PREDICT/Outliers_GB_80_No_PFI.dat:

Train: 1 outliers out of 29 datapoints (3.4%)

- 21 (2.8 SDs)

Validation: 1 outliers out of 8 datapoints (12.5%)

- 22 (2.4 SDs)

----- Starting model with PFI filter (only important descriptors used) -----

- o ML model RF_80_PFI (with PFI filter) and Xy database were loaded, including:

- Target value: Target_values
- Model: RF
- Descriptors: ['x6', 'x7', 'x9', 'x10']
- Training points: 29
- Validation points: 8
 - Train set with predicted results: RF_80_train_PFI.csv
 - Validation set with predicted results: RF_80_valid_PFI.csv

- o Saving graphs and CSV databases in:

- Graph in: PREDICT/Results_RF_80_PFI.png
- o Results saved in PREDICT/Results_RF_80_PFI.dat:
 - Points Train:Validation = 29:8
 - Proportion Train:Validation = 78:22
 - Number of descriptors = 4
 - Proportion points:descriptors = 37:4
 - Train : R2 = 0.98, MAE = 0.076, RMSE = 0.11
 - Validation : R2 = 0.97, MAE = 0.084, RMSE = 0.11
- o SHAP plot saved in PREDICT/SHAP_RF_80_PFI.png
- o SHAP values saved in PREDICT/SHAP_RF_80_PFI.dat:
 - x6 = min: -0.38, max: 0.21
 - x7 = min: -0.26, max: 0.18
 - x10 = min: -0.35, max: 0.13
 - x9 = min: -0.2, max: 0.062
- o PFI plot saved in PREDICT/PFI_RF_80_PFI.png
- o PFI values saved in PREDICT/PFI_RF_80_PFI.dat:
 - Original score (from model.score, R2) = 0.97
 - x6 = 0.24 +- 0.11
 - x7 = 0.18 +- 0.064
 - x10 = 0.15 +- 0.073
 - x9 = 0.047 +- 0.04
- o Outliers plot saved in PREDICT/Outliers_RF_80_PFI.png
- o Outlier values saved in PREDICT/Outliers_RF_80_PFI.dat:
 - Train: 1 outliers out of 29 datapoints (3.4%)
 - 21 (4.1 SDs)
 - Validation: 0 outliers out of 8 datapoints (0.0%)

Time PREDICT: 6.98 seconds

----- Images and summary generated by the PREDICT module -----

No PFI (all descriptors):

Results_GB_80_No_PFI.dat:

- Points Train:Validation = 29:8
- Proportion Train:Validation = 78:22
- Number of descriptors = 12
- Proportion points:descriptors = 37:12
- Train : R2 = 1.0, MAE = 0.025, RMSE = 0.031
- Validation : R2 = 0.98, MAE = 0.077, RMSE = 0.1

PFI (only important descriptors):

Results_RF_80_PFI.dat:

- Points Train:Validation = 29:8
- Proportion Train:Validation = 78:22
- Number of descriptors = 4
- Proportion points:descriptors = 37:4
- Train : R2 = 0.98, MAE = 0.076, RMSE = 0.11
- Validation : R2 = 0.97, MAE = 0.084, RMSE = 0.11

