

On the Use of Evaluation Measures for Defect Prediction Studies

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Abstract

This online appendix is supplementary to the paper titled "On the Use of Evaluation Measures for Defect Prediction Studies", which is submitted for review at ISSSTA 2022. It contains the data used in the study and the win-tie-loss results of our experiments. We will also include the scripts and confusion matrices upon acceptance.

1 Empirical Study Data

The datasets we used to run our experiments can be download from <https://figshare.com/s/f0a8168d34dcbb57bacf>.

2 Empirical Study Results

The results of the empirical study are described in Section 3 of the paper. Here we include the raw results of the win-tie-loss procedures used to compute the *discordant ranking* and *rank disruption* for the NASA datasets (Table 1) and Realistic datasets, cross-version (Tables 2 and 3) and cross-project (Tables 4 and 5).

| Dataset | | F1 win/loss/tie | G-measure win/loss/tie | MCC win/loss/tie | Balance win/loss/tie | AUC win/loss/tie | FPR win/loss/tie |
|---------|-----------|--------------------|---------------------------|---------------------|-------------------------|---------------------|---------------------|
| CM1 | Dummy | 5 / 1 / 0 | 5 / 0 / 1 | 0 / 3 / 3 | 5 / 0 / 1 | 1 / 5 / 0 | 0 / 6 / 0 |
| | SVM | 0 / 6 / 0 | 0 / 6 / 0 | 1 / 3 / 2 | 0 / 5 / 1 | 0 / 6 / 0 | 6 / 0 / 0 |
| | SVM_Tuned | 3 / 2 / 1 | 3 / 2 / 1 | 4 / 1 / 1 | 3 / 2 / 1 | 2 / 4 / 0 | 2 / 2 / 2 |
| | RF | 1 / 4 / 1 | 1 / 4 / 1 | 0 / 3 / 3 | 0 / 4 / 2 | 4 / 0 / 2 | 2 / 1 / 3 |
| | RF_Tuned | 1 / 4 / 1 | 1 / 4 / 1 | 0 / 4 / 2 | 1 / 4 / 1 | 4 / 0 / 2 | 3 / 1 / 2 |
| | NB | 6 / 0 / 0 | 5 / 0 / 1 | 5 / 0 / 1 | 5 / 0 / 1 | 4 / 0 / 2 | 1 / 5 / 0 |
| | LR | 3 / 2 / 1 | 3 / 2 / 1 | 4 / 0 / 2 | 3 / 2 / 1 | 3 / 3 / 0 | 2 / 1 / 3 |
| | | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large |
| | Dummy | 1 / 0 / 4 | 0 / 0 / 5 | 0 / 0 / 0 | 0 / 1 / 4 | 0 / 0 / 1 | 0 / 0 / 0 |
| | SVM | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 1 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 6 |
| | SVM_Tuned | 0 / 1 / 2 | 0 / 1 / 2 | 0 / 1 / 3 | 0 / 1 / 2 | 0 / 0 / 2 | 0 / 0 / 2 |
| | RF | 1 / 0 / 0 | 1 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 1 / 2 | 0 / 0 / 2 |
| | RF_Tuned | 0 / 0 / 1 | 0 / 0 / 1 | 0 / 0 / 0 | 0 / 0 / 1 | 0 / 1 / 3 | 0 / 0 / 3 |
| | NB | 1 / 1 / 4 | 0 / 0 / 5 | 1 / 2 / 2 | 0 / 1 / 4 | 1 / 0 / 3 | 0 / 0 / 1 |
| | LR | 2 / 0 / 1 | 2 / 0 / 1 | 3 / 1 / 0 | 3 / 0 / 0 | 0 / 1 / 2 | 0 / 0 / 2 |
| KC3 | | F1 win/loss/tie | G-measure win/loss/tie | MCC win/loss/tie | Balance win/loss/tie | AUC win/loss/tie | FPR win/loss/tie |
| | Dummy | 3 / 1 / 2 | 4 / 1 / 1 | 0 / 4 / 2 | 4 / 1 / 1 | 1 / 5 / 0 | 0 / 6 / 0 |
| | SVM | 0 / 6 / 0 | 0 / 6 / 0 | 1 / 4 / 1 | 0 / 6 / 0 | 0 / 6 / 0 | 6 / 0 / 0 |
| | SVM_Tuned | 1 / 5 / 0 | 1 / 5 / 0 | 0 / 5 / 1 | 1 / 5 / 0 | 2 / 4 / 0 | 3 / 2 / 1 |
| | RF | 3 / 1 / 2 | 3 / 2 / 1 | 3 / 1 / 2 | 3 / 2 / 1 | 4 / 1 / 1 | 3 / 1 / 2 |
| | RF_Tuned | 2 / 4 / 0 | 2 / 4 / 0 | 3 / 2 / 1 | 2 / 4 / 0 | 5 / 0 / 1 | 4 / 1 / 1 |
| | NB | 6 / 0 / 0 | 6 / 0 / 0 | 6 / 0 / 0 | 6 / 0 / 0 | 4 / 1 / 1 | 1 / 5 / 0 |
| | LR | 3 / 1 / 2 | 3 / 1 / 2 | 4 / 1 / 1 | 3 / 1 / 2 | 3 / 3 / 0 | 2 / 4 / 0 |
| | | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large |
| | Dummy | 0 / 0 / 3 | 0 / 1 / 3 | 0 / 0 / 0 | 1 / 0 / 3 | 0 / 0 / 1 | 0 / 0 / 0 |
| | SVM | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 1 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 1 / 5 |
| | SVM_Tuned | 0 / 0 / 1 | 0 / 0 / 1 | 0 / 0 / 0 | 0 / 0 / 1 | 0 / 0 / 2 | 0 / 0 / 3 |
| | RF | 0 / 1 / 0 | 0 / 1 / 0 | 1 / 2 / 0 | 1 / 0 / 0 | 1 / 0 / 3 | 0 / 1 / 2 |
| | RF_Tuned | 0 / 0 / 2 | 0 / 0 / 2 | 0 / 1 / 2 | 0 / 0 / 2 | 1 / 1 / 3 | 0 / 0 / 4 |
| | NB | 0 / 2 / 4 | 0 / 2 / 4 | 2 / 0 / 4 | 0 / 3 / 3 | 1 / 0 / 3 | 0 / 0 / 1 |
| | LR | 0 / 2 / 1 | 0 / 2 / 1 | 1 / 2 / 1 | 0 / 3 / 0 | 0 / 3 / 0 | 1 / 0 / 1 |
| MW1 | | F1 win/loss/tie | G-measure win/loss/tie | MCC win/loss/tie | Balance win/loss/tie | AUC win/loss/tie | FPR win/loss/tie |
| | Dummy | 2 / 1 / 3 | 5 / 1 / 0 | 0 / 4 / 2 | 4 / 1 / 1 | 1 / 4 / 1 | 0 / 6 / 0 |
| | SVM | 0 / 6 / 0 | 0 / 6 / 0 | 0 / 4 / 2 | 0 / 5 / 1 | 0 / 5 / 1 | 6 / 0 / 0 |
| | SVM_Tuned | 1 / 5 / 0 | 1 / 5 / 0 | 0 / 4 / 2 | 0 / 5 / 1 | 0 / 4 / 2 | 2 / 4 / 0 |
| | RF | 2 / 2 / 2 | 2 / 3 / 1 | 3 / 1 / 2 | 2 / 2 / 2 | 3 / 1 / 2 | 3 / 1 / 2 |
| | RF_Tuned | 2 / 2 / 2 | 2 / 3 / 1 | 3 / 2 / 1 | 2 / 3 / 1 | 3 / 1 / 2 | 4 / 1 / 1 |
| | NB | 6 / 0 / 0 | 6 / 0 / 0 | 5 / 0 / 1 | 6 / 0 / 0 | 6 / 0 / 0 | 1 / 5 / 0 |
| | LR | 4 / 1 / 1 | 4 / 2 / 0 | 4 / 0 / 2 | 3 / 1 / 2 | 3 / 1 / 2 | 3 / 2 / 1 |
| | | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large |
| | Dummy | 0 / 0 / 2 | 1 / 0 / 4 | 0 / 0 / 0 | 0 / 2 / 2 | 1 / 0 / 0 | 0 / 0 / 0 |
| | SVM | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 6 |
| | SVM_Tuned | 1 / 0 / 0 | 1 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 2 |
| | RF | 1 / 1 / 0 | 1 / 1 / 0 | 1 / 1 / 0 | 0 / 1 / 0 | 0 / 0 / 3 | 0 / 1 / 2 |
| | RF_Tuned | 0 / 1 / 1 | 0 / 1 / 1 | 1 / 1 / 1 | 0 / 1 / 1 | 0 / 0 / 3 | 1 / 1 / 2 |
| | NB | 1 / 0 / 5 | 0 / 0 / 6 | 0 / 2 / 3 | 0 / 0 / 6 | 2 / 1 / 3 | 0 / 0 / 1 |
| | LR | 2 / 1 / 1 | 1 / 1 / 1 | 1 / 1 / 1 | 1 / 1 / 0 | 0 / 0 / 3 | 0 / 1 / 2 |
| PC1 | | F1 win/loss/tie | G-measure win/loss/tie | MCC win/loss/tie | Balance win/loss/tie | AUC win/loss/tie | FPR win/loss/tie |
| | Dummy | 2 / 4 / 0 | 5 / 0 / 1 | 0 / 4 / 2 | 5 / 0 / 1 | 1 / 4 / 1 | 0 / 6 / 0 |
| | SVM | 0 / 6 / 0 | 0 / 6 / 0 | 0 / 4 / 2 | 0 / 6 / 0 | 0 / 6 / 0 | 6 / 0 / 0 |
| | SVM_Tuned | 1 / 5 / 0 | 1 / 5 / 0 | 0 / 4 / 2 | 1 / 5 / 0 | 1 / 4 / 1 | 2 / 4 / 0 |
| | RF | 4 / 0 / 2 | 3 / 2 / 1 | 5 / 0 / 1 | 3 / 2 / 1 | 4 / 1 / 1 | 4 / 1 / 1 |
| | RF_Tuned | 4 / 0 / 2 | 3 / 2 / 1 | 5 / 0 / 1 | 3 / 2 / 1 | 6 / 0 / 0 | 4 / 1 / 1 |
| | NB | 4 / 0 / 2 | 5 / 0 / 1 | 3 / 2 / 1 | 5 / 0 / 1 | 3 / 3 / 0 | 1 / 5 / 0 |
| | LR | 3 / 3 / 0 | 2 / 4 / 0 | 3 / 2 / 1 | 2 / 4 / 0 | 4 / 1 / 1 | 3 / 3 / 0 |
| | | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large |
| | Dummy | 0 / 1 / 1 | 0 / 1 / 4 | 0 / 0 / 0 | 0 / 3 / 2 | 0 / 0 / 1 | 0 / 0 / 0 |
| | SVM | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 1 / 5 |
| | SVM_Tuned | 0 / 1 / 0 | 0 / 1 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 1 | 1 / 0 / 1 |
| | RF | 1 / 0 / 3 | 0 / 0 / 2 | 2 / 0 / 3 | 1 / 0 / 2 | 0 / 1 / 3 | 0 / 1 / 3 |
| | RF_Tuned | 1 / 0 / 3 | 0 / 0 / 2 | 2 / 0 / 3 | 1 / 0 / 2 | 2 / 0 / 4 | 1 / 0 / 3 |
| | NB | 1 / 0 / 3 | 0 / 2 / 3 | 0 / 0 / 3 | 0 / 2 / 3 | 0 / 0 / 3 | 0 / 0 / 1 |
| | LR | 1 / 0 / 2 | 0 / 1 / 1 | 0 / 0 / 3 | 0 / 1 / 1 | 0 / 1 / 3 | 0 / 1 / 2 |
| PC3 | | F1 win/loss/tie | G-measure win/loss/tie | MCC win/loss/tie | Balance win/loss/tie | AUC win/loss/tie | FPR win/loss/tie |
| | Dummy | 2 / 1 / 3 | 6 / 0 / 0 | 1 / 4 / 1 | 6 / 0 / 0 | 0 / 6 / 0 | 1 / 5 / 0 |
| | SVM | 0 / 6 / 0 | 0 / 6 / 0 | 1 / 4 / 1 | 0 / 6 / 0 | 2 / 3 / 1 | 6 / 0 / 0 |
| | SVM_Tuned | 1 / 0 / 5 | 5 / 1 / 0 | 3 / 2 / 1 | 5 / 1 / 0 | 1 / 4 / 1 | 2 / 4 / 0 |
| | RF | 1 / 0 / 5 | 3 / 2 / 1 | 4 / 0 / 2 | 3 / 2 / 1 | 4 / 1 / 1 | 3 / 3 / 0 |
| | RF_Tuned | 1 / 2 / 3 | 2 / 3 / 1 | 4 / 0 / 2 | 2 / 3 / 1 | 6 / 0 / 0 | 4 / 1 / 1 |
| | NB | 4 / 0 / 2 | 1 / 5 / 0 | 0 / 6 / 0 | 1 / 5 / 0 | 4 / 1 / 1 | 0 / 6 / 0 |
| | LR | 1 / 1 / 4 | 2 / 2 / 2 | 3 / 0 / 3 | 2 / 2 / 2 | 1 / 3 / 2 | 4 / 1 / 1 |
| | | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large |
| | Dummy | 1 / 0 / 1 | 0 / 0 / 6 | 1 / 0 / 0 | 0 / 0 / 6 | 0 / 0 / 0 | 0 / 0 / 1 |
| | SVM | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 1 / 0 | 0 / 0 / 0 | 0 / 0 / 2 | 0 / 0 / 6 |
| | SVM_Tuned | 0 / 0 / 1 | 2 / 1 / 2 | 0 / 0 / 3 | 2 / 1 / 2 | 0 / 0 / 1 | 0 / 0 / 2 |
| | RF | 0 / 0 / 1 | 0 / 0 / 2 | 0 / 1 / 3 | 0 / 0 / 2 | 0 / 1 / 3 | 0 / 0 / 3 |
| | RF_Tuned | 0 / 0 / 1 | 0 / 0 / 2 | 0 / 1 / 3 | 0 / 0 / 2 | 0 / 0 / 6 | 1 / 0 / 3 |
| | NB | 1 / 1 / 1 | 0 / 0 / 1 | 0 / 0 / 0 | 0 / 0 / 1 | 0 / 1 / 3 | 0 / 0 / 0 |
| | LR | 0 / 0 / 1 | 0 / 0 / 1 | 0 / 2 / 1 | 0 / 1 / 0 | 1 / 0 / 0 | 0 / 1 / 3 |
| PC5 | | F1 win/loss/tie | G-measure win/loss/tie | MCC win/loss/tie | Balance win/loss/tie | AUC win/loss/tie | FPR win/loss/tie |
| | Dummy | 1 / 2 / 3 | 2 / 0 / 4 | 0 / 4 / 2 | 2 / 0 / 4 | 0 / 6 / 0 | 1 / 5 / 0 |
| | SVM | 0 / 6 / 0 | 0 / 6 / 0 | 0 / 4 / 2 | 0 / 6 / 0 | 2 / 1 / 3 | 6 / 0 / 0 |
| | SVM_Tuned | 5 / 0 / 1 | 3 / 0 / 3 | 5 / 0 / 1 | 3 / 0 / 3 | 1 / 4 / 1 | 2 / 2 / 2 |
| | RF | 1 / 2 / 3 | 2 / 1 / 3 | 3 / 3 / 0 | 2 / 1 / 3 | 3 / 1 / 2 | 2 / 2 / 2 |
| | RF_Tuned | 2 / 1 / 3 | 2 / 1 / 3 | 4 / 1 / 1 | 2 / 1 / 3 | 6 / 0 / 0 | 3 / 1 / 2 |
| | NB | 1 / 1 / 4 | 1 / 5 / 0 | 0 / 4 / 2 | 1 / 5 / 0 | 2 / 1 / 3 | 0 / 6 / 0 |
| | LR | 2 / 0 / 4 | 3 / 0 / 3 | 4 / 0 / 2 | 3 / 0 / 3 | 1 / 2 / 3 | 3 / 1 / 2 |
| | | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large |
| | Dummy | 0 / 0 / 1 | 0 / 1 / 1 | 0 / 0 / 0 | 1 / 1 / 0 | 0 / 0 / 0 | 0 / 0 / 1 |
| | SVM | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 2 | 0 / 1 / 5 |
| | SVM_Tuned | 3 / 1 / 1 | 0 / 0 / 3 | 1 / 1 / 3 | 0 / 0 / 3 | 0 / 0 / 1 | 0 / 0 / 2 |
| | RF | 0 / 0 / 1 | 1 / 0 / 1 | 3 / 0 / 0 | 1 / 1 / 0 | 1 / 1 / 1 | 0 / 0 / 2 |
| | RF_Tuned | 1 / 0 / 1 | 0 / 0 / 2 | 1 / 1 / 2 | 0 / 0 / 2 | 1 / 2 / 2 | 0 / 0 / 3 |
| | NB | 0 / 0 / 1 | 0 / 0 / 1 | 0 / 0 / 0 | 0 / 0 / 1 | 0 / 1 / 1 | 0 / 0 / 0 |
| | LR | 0 / 0 / 1 | 0 / 1 / 1 | 0 / 2 / 1 | 0 / 2 / 0 | 1 / 0 / 0 | 0 / 0 / 2 |

Table 1: The win-tie-loss results of the within-project scenario.

| Dataset | | F1 win/loss/tie | G-measure win/loss/tie | MCC win/loss/tie | Balance win/loss/tie | AUC win/loss/tie | FPR win/loss/tie |
|----------|-----------|--------------------|---------------------------|---------------------|-------------------------|---------------------|---------------------|
| ActiveMQ | Dummy | 1 / 5 / 0 | 1 / 4 / 1 | 1 / 5 / 0 | 1 / 5 / 0 | 0 / 6 / 0 | 0 / 6 / 0 |
| | SVM | 0 / 6 / 0 | 0 / 6 / 0 | 0 / 6 / 0 | 0 / 6 / 0 | 1 / 5 / 0 | 6 / 0 / 0 |
| | SVM_Tuned | 4 / 2 / 0 | 4 / 1 / 1 | 4 / 2 / 0 | 4 / 1 / 1 | 2 / 4 / 0 | 2 / 4 / 0 |
| | RF | 5 / 1 / 0 | 3 / 2 / 1 | 5 / 1 / 0 | 3 / 2 / 1 | 4 / 2 / 0 | 4 / 2 / 0 |
| | RF_Tuned | 6 / 0 / 0 | 3 / 1 / 2 | 6 / 0 / 0 | 3 / 1 / 2 | 6 / 0 / 0 | 5 / 1 / 0 |
| | NB | 2 / 4 / 0 | 6 / 0 / 0 | 3 / 3 / 0 | 6 / 0 / 0 | 5 / 1 / 0 | 1 / 5 / 0 |
| | LR | 3 / 3 / 0 | 1 / 4 / 1 | 2 / 4 / 0 | 2 / 4 / 0 | 3 / 3 / 0 | 3 / 3 / 0 |
| | | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large |
| | Dummy | 0 / 0 / 1 | 0 / 0 / 1 | 0 / 1 / 0 | 0 / 0 / 1 | 0 / 0 / 0 | 0 / 0 / 0 |
| | SVM | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 1 | 0 / 0 / 6 |
| | SVM_Tuned | 0 / 0 / 4 | 0 / 1 / 3 | 0 / 0 / 4 | 0 / 1 / 3 | 0 / 0 / 2 | 0 / 0 / 2 |
| | RF | 0 / 0 / 5 | 0 / 1 / 2 | 0 / 0 / 5 | 0 / 0 / 3 | 0 / 0 / 4 | 0 / 0 / 4 |
| | RF_Tuned | 0 / 0 / 6 | 0 / 0 / 3 | 0 / 0 / 6 | 0 / 0 / 3 | 0 / 0 / 6 | 0 / 0 / 5 |
| | NB | 0 / 0 / 2 | 0 / 0 / 6 | 0 / 0 / 3 | 0 / 0 / 6 | 0 / 0 / 5 | 0 / 0 / 1 |
| | LR | 0 / 0 / 3 | 0 / 0 / 1 | 0 / 0 / 2 | 0 / 0 / 2 | 0 / 0 / 3 | 0 / 0 / 3 |
| Camel | | F1 win/loss/tie | G-measure win/loss/tie | MCC win/loss/tie | Balance win/loss/tie | AUC win/loss/tie | FPR win/loss/tie |
| | Dummy | 2 / 4 / 0 | 5 / 1 / 0 | 2 / 4 / 0 | 5 / 1 / 0 | 1 / 5 / 0 | 0 / 6 / 0 |
| | SVM | 0 / 6 / 0 | 0 / 6 / 0 | 1 / 5 / 0 | 1 / 5 / 0 | 6 / 0 / 0 | 6 / 0 / 0 |
| | SVM_Tuned | 5 / 1 / 0 | 4 / 2 / 0 | 3 / 2 / 1 | 4 / 2 / 0 | 2 / 4 / 0 | 2 / 4 / 0 |
| | RF | 3 / 2 / 1 | 3 / 3 / 0 | 3 / 2 / 1 | 3 / 3 / 0 | 3 / 3 / 0 | 3 / 3 / 0 |
| | RF_Tuned | 3 / 2 / 1 | 2 / 4 / 0 | 5 / 1 / 0 | 2 / 4 / 0 | 5 / 1 / 0 | 4 / 2 / 0 |
| | NB | 6 / 0 / 0 | 6 / 0 / 0 | 6 / 0 / 0 | 6 / 0 / 0 | 4 / 2 / 0 | 1 / 5 / 0 |
| | LR | 0 / 6 / 0 | 0 / 6 / 0 | 0 / 6 / 0 | 0 / 6 / 0 | 0 / 6 / 0 | 5 / 1 / 0 |
| | | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large |
| | Dummy | 0 / 0 / 2 | 0 / 0 / 5 | 0 / 1 / 1 | 0 / 0 / 5 | 0 / 0 / 1 | 0 / 0 / 0 |
| | SVM | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 1 | 0 / 0 / 1 | 0 / 0 / 6 | 0 / 0 / 6 |
| | SVM_Tuned | 1 / 0 / 4 | 0 / 1 / 3 | 0 / 0 / 3 | 0 / 1 / 3 | 0 / 0 / 2 | 0 / 0 / 2 |
| | RF | 0 / 0 / 3 | 1 / 0 / 2 | 0 / 0 / 3 | 1 / 0 / 2 | 0 / 0 / 3 | 0 / 0 / 3 |
| | RF_Tuned | 0 / 0 / 3 | 0 / 0 / 2 | 1 / 1 / 3 | 0 / 0 / 2 | 0 / 0 / 5 | 0 / 1 / 3 |
| | NB | 0 / 0 / 6 | 0 / 1 / 5 | 0 / 0 / 6 | 0 / 0 / 6 | 0 / 0 / 4 | 0 / 0 / 1 |
| | LR | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 5 |
| Derby | | F1 win/loss/tie | G-measure win/loss/tie | MCC win/loss/tie | Balance win/loss/tie | AUC win/loss/tie | FPR win/loss/tie |
| | Dummy | 2 / 4 / 0 | 3 / 3 / 0 | 0 / 6 / 0 | 3 / 3 / 0 | 0 / 6 / 0 | 1 / 5 / 0 |
| | SVM | 1 / 5 / 0 | 1 / 5 / 0 | 1 / 5 / 0 | 1 / 5 / 0 | 3 / 3 / 0 | 5 / 1 / 0 |
| | SVM_Tuned | 4 / 2 / 0 | 5 / 1 / 0 | 5 / 1 / 0 | 5 / 1 / 0 | 1 / 5 / 0 | 3 / 3 / 0 |
| | RF | 5 / 0 / 1 | 6 / 0 / 0 | 4 / 2 / 0 | 6 / 0 / 0 | 5 / 1 / 0 | 2 / 4 / 0 |
| | RF_Tuned | 5 / 0 / 1 | 4 / 2 / 0 | 6 / 0 / 0 | 4 / 2 / 0 | 6 / 0 / 0 | 4 / 2 / 0 |
| | NB | 0 / 6 / 0 | 0 / 6 / 0 | 2 / 4 / 0 | 0 / 6 / 0 | 4 / 2 / 0 | 6 / 0 / 0 |
| | LR | 3 / 3 / 0 | 2 / 4 / 0 | 3 / 3 / 0 | 2 / 4 / 0 | 2 / 4 / 0 | 0 / 6 / 0 |
| | | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large |
| | Dummy | 0 / 0 / 2 | 0 / 0 / 3 | 0 / 0 / 0 | 0 / 0 / 3 | 0 / 0 / 0 | 0 / 0 / 1 |
| | SVM | 0 / 0 / 1 | 0 / 0 / 1 | 0 / 0 / 1 | 0 / 0 / 1 | 0 / 0 / 3 | 0 / 0 / 5 |
| | SVM_Tuned | 0 / 0 / 4 | 0 / 0 / 5 | 1 / 0 / 4 | 0 / 0 / 5 | 0 / 0 / 1 | 0 / 0 / 3 |
| | RF | 1 / 0 / 4 | 0 / 0 / 6 | 0 / 0 / 4 | 0 / 0 / 6 | 0 / 0 / 5 | 0 / 0 / 2 |
| | RF_Tuned | 0 / 0 / 5 | 0 / 0 / 4 | 0 / 0 / 6 | 0 / 0 / 4 | 0 / 0 / 6 | 0 / 0 / 4 |
| | NB | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 2 | 0 / 0 / 0 | 0 / 0 / 4 | 0 / 0 / 6 |
| | LR | 0 / 0 / 3 | 0 / 0 / 2 | 0 / 0 / 3 | 0 / 0 / 2 | 0 / 0 / 2 | 0 / 0 / 0 |
| Groovy | | F1 win/loss/tie | G-measure win/loss/tie | MCC win/loss/tie | Balance win/loss/tie | AUC win/loss/tie | FPR win/loss/tie |
| | Dummy | 2 / 4 / 0 | 6 / 0 / 0 | 1 / 5 / 0 | 6 / 0 / 0 | 1 / 5 / 0 | 1 / 5 / 0 |
| | SVM | 0 / 6 / 0 | 1 / 5 / 0 | 2 / 4 / 0 | 1 / 5 / 0 | 4 / 1 / 1 | 5 / 1 / 0 |
| | SVM_Tuned | 5 / 1 / 0 | 4 / 2 / 0 | 4 / 2 / 0 | 4 / 2 / 0 | 3 / 3 / 0 | 2 / 4 / 0 |
| | RF | 6 / 0 / 0 | 5 / 1 / 0 | 6 / 0 / 0 | 5 / 1 / 0 | 4 / 1 / 1 | 3 / 3 / 0 |
| | RF_Tuned | 4 / 2 / 0 | 3 / 3 / 0 | 5 / 1 / 0 | 3 / 3 / 0 | 6 / 0 / 0 | 4 / 2 / 0 |
| | NB | 3 / 3 / 0 | 0 / 6 / 0 | 0 / 6 / 0 | 0 / 6 / 0 | 2 / 4 / 0 | 0 / 6 / 0 |
| | LR | 1 / 5 / 0 | 2 / 4 / 0 | 3 / 3 / 0 | 2 / 4 / 0 | 0 / 6 / 0 | 6 / 0 / 0 |
| | | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large |
| | Dummy | 0 / 0 / 2 | 0 / 0 / 6 | 0 / 0 / 1 | 0 / 1 / 5 | 0 / 0 / 1 | 0 / 0 / 1 |
| | SVM | 0 / 0 / 0 | 0 / 0 / 1 | 0 / 0 / 2 | 0 / 0 / 1 | 0 / 0 / 4 | 0 / 1 / 4 |
| | SVM_Tuned | 0 / 0 / 5 | 0 / 0 / 4 | 0 / 0 / 4 | 0 / 0 / 4 | 0 / 0 / 3 | 0 / 0 / 2 |
| | RF | 0 / 0 / 6 | 0 / 1 / 4 | 0 / 1 / 5 | 0 / 1 / 4 | 0 / 0 / 4 | 0 / 0 / 3 |
| | RF_Tuned | 0 / 0 / 4 | 0 / 0 / 3 | 0 / 0 / 5 | 0 / 0 / 3 | 0 / 0 / 6 | 0 / 0 / 4 |
| | NB | 0 / 0 / 3 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 2 | 0 / 0 / 0 |
| | LR | 0 / 0 / 1 | 0 / 0 / 2 | 0 / 0 / 3 | 0 / 0 / 2 | 0 / 0 / 0 | 0 / 0 / 6 |
| HBase | | F1 win/loss/tie | G-measure win/loss/tie | MCC win/loss/tie | Balance win/loss/tie | AUC win/loss/tie | FPR win/loss/tie |
| | Dummy | 3 / 3 / 0 | 6 / 0 / 0 | 1 / 5 / 0 | 4 / 1 / 1 | 1 / 5 / 0 | 0 / 6 / 0 |
| | SVM | 1 / 5 / 0 | 1 / 5 / 0 | 0 / 6 / 0 | 1 / 5 / 0 | 3 / 3 / 0 | 5 / 1 / 0 |
| | SVM_Tuned | 4 / 2 / 0 | 3 / 3 / 0 | 4 / 2 / 0 | 3 / 3 / 0 | 2 / 4 / 0 | 1 / 5 / 0 |
| | RF | 5 / 1 / 0 | 5 / 1 / 0 | 5 / 1 / 0 | 6 / 0 / 0 | 4 / 2 / 0 | 2 / 4 / 0 |
| | RF_Tuned | 6 / 0 / 0 | 4 / 2 / 0 | 6 / 0 / 0 | 4 / 1 / 1 | 5 / 0 / 1 | 3 / 3 / 0 |
| | NB | 0 / 6 / 0 | 0 / 6 / 0 | 3 / 3 / 0 | 0 / 6 / 0 | 5 / 0 / 1 | 6 / 0 / 0 |
| | LR | 2 / 4 / 0 | 2 / 4 / 0 | 2 / 4 / 0 | 2 / 4 / 0 | 0 / 6 / 0 | 4 / 2 / 0 |
| | | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large |
| | Dummy | 0 / 0 / 3 | 0 / 0 / 6 | 0 / 0 / 1 | 0 / 1 / 3 | 0 / 0 / 1 | 0 / 0 / 0 |
| | SVM | 0 / 0 / 1 | 0 / 0 / 1 | 0 / 0 / 0 | 0 / 0 / 1 | 0 / 0 / 3 | 0 / 0 / 5 |
| | SVM_Tuned | 0 / 1 / 3 | 0 / 0 / 3 | 0 / 0 / 4 | 0 / 0 / 3 | 0 / 0 / 2 | 0 / 0 / 1 |
| | RF | 0 / 0 / 5 | 1 / 0 / 4 | 0 / 0 / 5 | 1 / 1 / 4 | 0 / 0 / 4 | 0 / 0 / 2 |
| | RF_Tuned | 1 / 0 / 5 | 1 / 0 / 3 | 0 / 0 / 6 | 0 / 1 / 3 | 0 / 0 / 5 | 0 / 0 / 3 |
| | NB | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 3 | 0 / 0 / 0 | 0 / 0 / 5 | 0 / 0 / 6 |
| | LR | 0 / 0 / 2 | 0 / 0 / 2 | 0 / 0 / 2 | 0 / 0 / 2 | 0 / 0 / 0 | 0 / 0 / 4 |
| Hive | | F1 win/loss/tie | G-measure win/loss/tie | MCC win/loss/tie | Balance win/loss/tie | AUC win/loss/tie | FPR win/loss/tie |
| | Dummy | 3 / 3 / 0 | 3 / 2 / 1 | 1 / 4 / 1 | 3 / 3 / 0 | 2 / 4 / 0 | 0 / 6 / 0 |
| | SVM | 0 / 6 / 0 | 0 / 6 / 0 | 0 / 6 / 0 | 0 / 6 / 0 | 4 / 2 / 0 | 6 / 0 / 0 |
| | SVM_Tuned | 4 / 2 / 0 | 3 / 2 / 1 | 4 / 2 / 0 | 4 / 2 / 0 | 0 / 5 / 1 | 3 / 3 / 0 |
| | RF | 5 / 1 / 0 | 5 / 1 / 0 | 5 / 1 / 0 | 5 / 1 / 0 | 5 / 1 / 0 | 2 / 4 / 0 |
| | RF_Tuned | 6 / 0 / 0 | 6 / 0 / 0 | 6 / 0 / 0 | 6 / 0 / 0 | 6 / 0 / 0 | 1 / 5 / 0 |
| | NB | 1 / 5 / 0 | 1 / 5 / 0 | 1 / 4 / 1 | 1 / 5 / 0 | 3 / 3 / 0 | 5 / 1 / 0 |
| | LR | 2 / 4 / 0 | 2 / 4 / 0 | 3 / 3 / 0 | 2 / 4 / 0 | 0 / 5 / 1 | 4 / 2 / 0 |
| | | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large |
| | Dummy | 0 / 0 / 3 | 0 / 0 / 3 | 0 / 1 / 0 | 0 / 0 / 3 | 1 / 0 / 1 | 0 / 0 / 0 |
| | SVM | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 4 | 0 / 0 / 6 |
| | SVM_Tuned | 0 / 0 / 4 | 0 / 0 / 3 | 0 / 0 / 4 | 0 / 0 / 4 | 0 / 0 / 0 | 1 / 0 / 2 |
| | RF | 0 / 0 / 5 | 0 / 0 / 5 | 0 / 0 / 5 | 0 / 0 / 5 | 0 / 0 / 5 | 1 / 0 / 1 |
| | RF_Tuned | 0 / 0 / 6 | 0 / 0 / 6 | 0 / 0 / 6 | 0 / 0 / 6 | 0 / 0 / 6 | 0 / 0 / 1 |
| | NB | 0 / 0 / 1 | 0 / 0 / 1 | 0 / 0 / 1 | 0 / 0 / 1 | 0 / 0 / 3 | 0 / 0 / 5 |
| | LR | 0 / 0 / 2 | 0 / 0 / 2 | 0 / 0 / 3 | 0 / 0 / 2 | 0 / 0 / 0 | 0 / 0 / 4 |

Table 2: The win-tie-loss results of the cross-version scenario.

| Dataset | F1 | G-measure | MCC | Balance | AUC | FPR |
|-----------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| | win/loss/tie | win/loss/tie | win/loss/tie | win/loss/tie | win/loss/tie | win/loss/tie |
| Dummy | 1 / 5 / 0 | 4 / 1 / 1 | 1 / 5 / 0 | 3 / 2 / 1 | 2 / 4 / 0 | 0 / 6 / 0 |
| SVM | 0 / 6 / 0 | 0 / 6 / 0 | 0 / 6 / 0 | 0 / 6 / 0 | 3 / 3 / 0 | 6 / 0 / 0 |
| SVM_Tuned | 3 / 3 / 0 | 1 / 5 / 0 | 3 / 3 / 0 | 1 / 5 / 0 | 0 / 6 / 0 | 2 / 4 / 0 |
| RF | 5 / 1 / 0 | 4 / 1 / 1 | 5 / 1 / 0 | 5 / 1 / 0 | 4 / 1 / 1 | 3 / 3 / 0 |
| RF_Tuned | 6 / 0 / 0 | 3 / 3 / 0 | 6 / 0 / 0 | 3 / 2 / 1 | 6 / 0 / 0 | 5 / 1 / 0 |
| NB | 4 / 2 / 0 | 2 / 4 / 0 | 4 / 2 / 0 | 2 / 4 / 0 | 4 / 1 / 1 | 4 / 2 / 0 |
| LR | 2 / 4 / 0 | 6 / 0 / 0 | 2 / 4 / 0 | 6 / 0 / 0 | 1 / 5 / 0 | 1 / 5 / 0 |
| JRuby | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large |
| Dummy | 0 / 0 / 1 | 0 / 0 / 4 | 0 / 1 / 0 | 0 / 0 / 3 | 0 / 0 / 2 | 0 / 0 / 0 |
| SVM | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 3 | 0 / 0 / 6 |
| SVM_Tuned | 0 / 0 / 3 | 0 / 0 / 1 | 0 / 0 / 3 | 0 / 0 / 1 | 0 / 0 / 0 | 0 / 0 / 2 |
| RF | 0 / 0 / 5 | 0 / 0 / 3 | 0 / 0 / 5 | 0 / 0 / 3 | 0 / 0 / 4 | 0 / 0 / 3 |
| RF_Tuned | 0 / 0 / 6 | 0 / 0 / 3 | 0 / 0 / 6 | 0 / 0 / 3 | 0 / 0 / 6 | 0 / 0 / 5 |
| NB | 0 / 0 / 4 | 0 / 0 / 2 | 0 / 0 / 4 | 0 / 0 / 2 | 0 / 0 / 4 | 1 / 0 / 3 |
| LR | 0 / 0 / 2 | 0 / 0 / 6 | 0 / 0 / 2 | 0 / 0 / 6 | 0 / 0 / 1 | 0 / 0 / 1 |
| | F1 | G-measure | MCC | Balance | AUC | FPR |
| | win/loss/tie | win/loss/tie | win/loss/tie | win/loss/tie | win/loss/tie | win/loss/tie |
| Dummy | 3 / 1 / 2 | 6 / 0 / 0 | 0 / 5 / 1 | 6 / 0 / 0 | 1 / 5 / 0 | 0 / 6 / 0 |
| SVM | 0 / 6 / 0 | 0 / 6 / 0 | 0 / 5 / 1 | 0 / 6 / 0 | 3 / 2 / 1 | 6 / 0 / 0 |
| SVM_Tuned | 6 / 0 / 0 | 5 / 1 / 0 | 4 / 1 / 1 | 5 / 1 / 0 | 2 / 4 / 0 | 1 / 5 / 0 |
| RF | 3 / 1 / 2 | 3 / 2 / 1 | 2 / 2 / 2 | 3 / 2 / 1 | 3 / 2 / 1 | 2 / 4 / 0 |
| RF_Tuned | 3 / 1 / 2 | 3 / 2 / 1 | 3 / 1 / 2 | 3 / 2 / 1 | 5 / 0 / 1 | 3 / 3 / 0 |
| NB | 2 / 4 / 0 | 2 / 4 / 0 | 6 / 0 / 0 | 2 / 4 / 0 | 5 / 0 / 1 | 5 / 1 / 0 |
| LR | 1 / 5 / 0 | 1 / 5 / 0 | 2 / 3 / 1 | 1 / 5 / 0 | 0 / 6 / 0 | 4 / 2 / 0 |
| Lucene | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large |
| Dummy | 0 / 0 / 3 | 0 / 0 / 6 | 0 / 0 / 0 | 0 / 0 / 6 | 0 / 0 / 1 | 0 / 0 / 0 |
| SVM | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 3 | 0 / 0 / 6 |
| SVM_Tuned | 0 / 0 / 6 | 0 / 0 / 5 | 0 / 1 / 3 | 0 / 0 / 5 | 0 / 0 / 2 | 0 / 0 / 1 |
| RF | 1 / 0 / 2 | 0 / 0 / 3 | 0 / 0 / 2 | 0 / 0 / 3 | 0 / 0 / 3 | 0 / 0 / 2 |
| RF_Tuned | 0 / 0 / 3 | 0 / 0 / 3 | 0 / 0 / 3 | 0 / 0 / 3 | 0 / 0 / 5 | 0 / 0 / 3 |
| NB | 0 / 0 / 2 | 0 / 0 / 2 | 0 / 0 / 6 | 0 / 0 / 2 | 0 / 0 / 5 | 0 / 0 / 5 |
| LR | 0 / 0 / 1 | 0 / 0 / 1 | 0 / 0 / 2 | 0 / 0 / 1 | 0 / 0 / 0 | 0 / 0 / 4 |
| | F1 | G-measure | MCC | Balance | AUC | FPR |
| | win/loss/tie | win/loss/tie | win/loss/tie | win/loss/tie | win/loss/tie | win/loss/tie |
| Dummy | 3 / 3 / 0 | 5 / 0 / 1 | 0 / 4 / 2 | 5 / 1 / 0 | 1 / 5 / 0 | 0 / 6 / 0 |
| SVM | 0 / 6 / 0 | 0 / 6 / 0 | 1 / 4 / 1 | 1 / 5 / 0 | 2 / 4 / 0 | 6 / 0 / 0 |
| SVM_Tuned | 2 / 4 / 0 | 2 / 4 / 0 | 3 / 3 / 0 | 2 / 4 / 0 | 3 / 3 / 0 | 3 / 3 / 0 |
| RF | 5 / 1 / 0 | 4 / 2 / 0 | 4 / 2 / 0 | 4 / 2 / 0 | 4 / 2 / 0 | 2 / 4 / 0 |
| RF_Tuned | 4 / 2 / 0 | 3 / 3 / 0 | 5 / 1 / 0 | 3 / 3 / 0 | 6 / 0 / 0 | 4 / 2 / 0 |
| NB | 6 / 0 / 0 | 5 / 0 / 1 | 6 / 0 / 0 | 6 / 0 / 0 | 5 / 1 / 0 | 1 / 5 / 0 |
| LR | 0 / 6 / 0 | 0 / 6 / 0 | 0 / 5 / 1 | 0 / 6 / 0 | 0 / 6 / 0 | 5 / 1 / 0 |
| Wicket | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large |
| Dummy | 0 / 0 / 3 | 0 / 0 / 5 | 0 / 0 / 0 | 0 / 0 / 5 | 0 / 0 / 1 | 0 / 0 / 0 |
| SVM | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 1 | 0 / 0 / 1 | 0 / 0 / 2 | 0 / 0 / 6 |
| SVM_Tuned | 0 / 0 / 2 | 0 / 0 / 2 | 0 / 0 / 3 | 0 / 0 / 2 | 0 / 0 / 3 | 0 / 0 / 3 |
| RF | 1 / 0 / 4 | 0 / 1 / 3 | 0 / 0 / 4 | 0 / 1 / 3 | 0 / 1 / 3 | 0 / 0 / 2 |
| RF_Tuned | 0 / 0 / 4 | 0 / 0 / 3 | 1 / 0 / 4 | 0 / 0 / 3 | 0 / 0 / 6 | 0 / 0 / 4 |
| NB | 0 / 0 / 6 | 0 / 0 / 5 | 0 / 0 / 6 | 0 / 0 / 6 | 0 / 0 / 5 | 0 / 0 / 1 |
| LR | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 5 |

Table 3: The win-tie-loss results of the cross-version scenario.

| Dataset | | F1 win/loss/tie | G-measure win/loss/tie | MCC win/loss/tie | Balance win/loss/tie | AUC win/loss/tie | FPR win/loss/tie |
|----------|-----------|--------------------|---------------------------|---------------------|-------------------------|---------------------|---------------------|
| ActiveMQ | Dummy | 3 / 2 / 1 | 6 / 0 / 0 | 1 / 4 / 1 | 6 / 0 / 0 | 1 / 5 / 0 | 0 / 6 / 0 |
| | SVM | 0 / 6 / 0 | 0 / 6 / 0 | 0 / 6 / 0 | 0 / 6 / 0 | 3 / 3 / 0 | 2 / 4 / 0 |
| | SVM_Tuned | 6 / 0 / 0 | 5 / 1 / 0 | 5 / 1 / 0 | 5 / 1 / 0 | 2 / 4 / 0 | 1 / 5 / 0 |
| | RF | 5 / 1 / 0 | 4 / 2 / 0 | 4 / 2 / 0 | 4 / 2 / 0 | 4 / 2 / 0 | 3 / 3 / 0 |
| | RF_Tuned | 3 / 2 / 1 | 3 / 3 / 0 | 6 / 0 / 0 | 3 / 3 / 0 | 5 / 0 / 1 | 5 / 1 / 0 |
| | NB | 0 / 6 / 0 | 0 / 6 / 0 | 1 / 4 / 1 | 1 / 5 / 0 | 5 / 0 / 1 | 6 / 0 / 0 |
| | LR | 2 / 4 / 0 | 2 / 4 / 0 | 3 / 3 / 0 | 2 / 4 / 0 | 0 / 6 / 0 | 4 / 2 / 0 |
| | | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large |
| | Dummy | 0 / 0 / 3 | 0 / 0 / 6 | 0 / 0 / 1 | 0 / 0 / 6 | 0 / 0 / 1 | 0 / 0 / 0 |
| | SVM | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 3 | 0 / 0 / 2 |
| | SVM_Tuned | 0 / 0 / 6 | 0 / 0 / 5 | 0 / 0 / 5 | 0 / 0 / 5 | 0 / 0 / 2 | 0 / 0 / 1 |
| | RF | 0 / 1 / 4 | 0 / 0 / 4 | 0 / 0 / 4 | 0 / 0 / 4 | 0 / 0 / 4 | 0 / 0 / 3 |
| | RF_Tuned | 0 / 0 / 3 | 0 / 0 / 3 | 0 / 0 / 5 | 0 / 0 / 3 | 0 / 0 / 5 | 0 / 0 / 5 |
| | NB | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 1 | 0 / 0 / 1 | 0 / 0 / 5 | 1 / 0 / 5 |
| | LR | 0 / 0 / 2 | 0 / 0 / 2 | 0 / 0 / 3 | 0 / 0 / 2 | 0 / 0 / 0 | 0 / 0 / 4 |
| Camel | | F1 win/loss/tie | G-measure win/loss/tie | MCC win/loss/tie | Balance win/loss/tie | AUC win/loss/tie | FPR win/loss/tie |
| | Dummy | 3 / 3 / 0 | 6 / 0 / 0 | 0 / 4 / 2 | 6 / 0 / 0 | 1 / 5 / 0 | 0 / 6 / 0 |
| | SVM | 0 / 6 / 0 | 0 / 6 / 0 | 0 / 5 / 1 | 0 / 6 / 0 | 4 / 2 / 0 | 5 / 1 / 0 |
| | SVM_Tuned | 4 / 2 / 0 | 3 / 3 / 0 | 4 / 2 / 0 | 3 / 3 / 0 | 2 / 4 / 0 | 1 / 4 / 1 |
| | RF | 5 / 1 / 0 | 5 / 1 / 0 | 5 / 1 / 0 | 5 / 1 / 0 | 3 / 3 / 0 | 1 / 4 / 1 |
| | RF_Tuned | 6 / 0 / 0 | 4 / 2 / 0 | 6 / 0 / 0 | 4 / 2 / 0 | 6 / 0 / 0 | 4 / 2 / 0 |
| | NB | 0 / 6 / 0 | 0 / 6 / 0 | 1 / 4 / 1 | 1 / 5 / 0 | 5 / 1 / 0 | 6 / 0 / 0 |
| | LR | 2 / 4 / 0 | 2 / 4 / 0 | 3 / 3 / 0 | 2 / 4 / 0 | 0 / 6 / 0 | 3 / 3 / 0 |
| | | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large |
| | Dummy | 0 / 0 / 3 | 0 / 0 / 6 | 0 / 0 / 0 | 0 / 0 / 6 | 0 / 0 / 1 | 0 / 0 / 0 |
| | SVM | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 4 | 0 / 0 / 5 |
| | SVM_Tuned | 0 / 0 / 4 | 0 / 0 / 3 | 0 / 0 / 4 | 0 / 0 / 3 | 0 / 0 / 2 | 0 / 0 / 1 |
| | RF | 0 / 0 / 5 | 0 / 0 / 4 | 0 / 0 / 5 | 0 / 0 / 4 | 0 / 0 / 3 | 0 / 0 / 1 |
| | RF_Tuned | 0 / 1 / 5 | 0 / 0 / 4 | 0 / 0 / 6 | 0 / 0 / 4 | 0 / 0 / 6 | 0 / 0 / 4 |
| | NB | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 1 | 0 / 0 / 1 | 0 / 0 / 5 | 0 / 0 / 6 |
| | LR | 0 / 0 / 2 | 0 / 0 / 2 | 0 / 0 / 3 | 0 / 0 / 2 | 0 / 0 / 0 | 0 / 0 / 3 |
| Derby | | F1 win/loss/tie | G-measure win/loss/tie | MCC win/loss/tie | Balance win/loss/tie | AUC win/loss/tie | FPR win/loss/tie |
| | Dummy | 6 / 0 / 0 | 6 / 0 / 0 | 1 / 4 / 1 | 6 / 0 / 0 | 2 / 4 / 0 | 0 / 6 / 0 |
| | SVM | 0 / 6 / 0 | 0 / 6 / 0 | 0 / 6 / 0 | 0 / 6 / 0 | 3 / 3 / 0 | 6 / 0 / 0 |
| | SVM_Tuned | 5 / 1 / 0 | 5 / 1 / 0 | 4 / 2 / 0 | 5 / 1 / 0 | 1 / 5 / 0 | 1 / 5 / 0 |
| | RF | 4 / 2 / 0 | 4 / 2 / 0 | 6 / 0 / 0 | 4 / 2 / 0 | 4 / 2 / 0 | 2 / 4 / 0 |
| | RF_Tuned | 2 / 4 / 0 | 2 / 4 / 0 | 5 / 1 / 0 | 2 / 4 / 0 | 5 / 0 / 1 | 5 / 1 / 0 |
| | NB | 3 / 3 / 0 | 3 / 3 / 0 | 3 / 3 / 0 | 3 / 3 / 0 | 5 / 0 / 1 | 3 / 3 / 0 |
| | LR | 1 / 5 / 0 | 1 / 5 / 0 | 1 / 4 / 1 | 1 / 5 / 0 | 0 / 6 / 0 | 4 / 2 / 0 |
| | | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large |
| | Dummy | 0 / 0 / 6 | 0 / 0 / 6 | 0 / 1 / 0 | 0 / 0 / 6 | 0 / 0 / 2 | 0 / 0 / 0 |
| | SVM | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 3 | 1 / 0 / 5 |
| | SVM_Tuned | 0 / 0 / 5 | 0 / 0 / 5 | 0 / 0 / 4 | 0 / 0 / 5 | 0 / 0 / 1 | 0 / 0 / 1 |
| | RF | 0 / 0 / 4 | 0 / 0 / 4 | 1 / 1 / 4 | 0 / 0 / 4 | 0 / 0 / 4 | 0 / 0 / 2 |
| | RF_Tuned | 0 / 0 / 2 | 0 / 0 / 2 | 0 / 0 / 5 | 0 / 0 / 2 | 0 / 0 / 5 | 0 / 0 / 5 |
| | NB | 0 / 0 / 3 | 0 / 0 / 3 | 0 / 0 / 3 | 0 / 0 / 3 | 0 / 0 / 5 | 1 / 0 / 2 |
| | LR | 0 / 0 / 1 | 0 / 0 / 1 | 0 / 0 / 1 | 0 / 0 / 1 | 0 / 0 / 0 | 0 / 0 / 4 |
| Groovy | | F1 win/loss/tie | G-measure win/loss/tie | MCC win/loss/tie | Balance win/loss/tie | AUC win/loss/tie | FPR win/loss/tie |
| | Dummy | 4 / 2 / 0 | 6 / 0 / 0 | 0 / 4 / 2 | 6 / 0 / 0 | 2 / 4 / 0 | 0 / 6 / 0 |
| | SVM | 0 / 6 / 0 | 0 / 6 / 0 | 1 / 4 / 1 | 1 / 5 / 0 | 4 / 1 / 1 | 6 / 0 / 0 |
| | SVM_Tuned | 3 / 3 / 0 | 3 / 3 / 0 | 3 / 3 / 0 | 3 / 3 / 0 | 1 / 5 / 0 | 1 / 4 / 1 |
| | RF | 6 / 0 / 0 | 5 / 1 / 0 | 5 / 1 / 0 | 5 / 1 / 0 | 3 / 1 / 2 | 1 / 4 / 1 |
| | RF_Tuned | 5 / 1 / 0 | 4 / 2 / 0 | 6 / 0 / 0 | 4 / 2 / 0 | 6 / 0 / 0 | 3 / 3 / 0 |
| | NB | 2 / 4 / 0 | 2 / 4 / 0 | 4 / 2 / 0 | 2 / 4 / 0 | 3 / 2 / 1 | 4 / 2 / 0 |
| | LR | 0 / 6 / 0 | 0 / 6 / 0 | 0 / 5 / 1 | 0 / 6 / 0 | 0 / 6 / 0 | 4 / 2 / 0 |
| | | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large |
| | Dummy | 0 / 0 / 4 | 0 / 0 / 6 | 0 / 0 / 0 | 0 / 0 / 6 | 0 / 0 / 2 | 0 / 0 / 0 |
| | SVM | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 1 | 0 / 0 / 1 | 0 / 0 / 4 | 0 / 0 / 6 |
| | SVM_Tuned | 0 / 0 / 3 | 0 / 0 / 3 | 0 / 0 / 3 | 0 / 0 / 3 | 0 / 0 / 1 | 0 / 0 / 1 |
| | RF | 0 / 1 / 5 | 0 / 1 / 4 | 0 / 0 / 5 | 0 / 1 / 4 | 0 / 0 / 3 | 0 / 0 / 1 |
| | RF_Tuned | 0 / 0 / 5 | 0 / 0 / 4 | 1 / 0 / 5 | 0 / 0 / 4 | 0 / 0 / 6 | 0 / 0 / 3 |
| | NB | 0 / 0 / 2 | 0 / 0 / 2 | 0 / 0 / 4 | 0 / 0 / 2 | 0 / 0 / 3 | 0 / 0 / 4 |
| | LR | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 4 |
| HBase | | F1 win/loss/tie | G-measure win/loss/tie | MCC win/loss/tie | Balance win/loss/tie | AUC win/loss/tie | FPR win/loss/tie |
| | Dummy | 6 / 0 / 0 | 6 / 0 / 0 | 1 / 4 / 1 | 6 / 0 / 0 | 1 / 5 / 0 | 0 / 6 / 0 |
| | SVM | 0 / 6 / 0 | 0 / 6 / 0 | 1 / 4 / 1 | 1 / 5 / 0 | 3 / 3 / 0 | 6 / 0 / 0 |
| | SVM_Tuned | 3 / 3 / 0 | 3 / 2 / 1 | 4 / 2 / 0 | 3 / 2 / 1 | 2 / 4 / 0 | 1 / 5 / 0 |
| | RF | 4 / 1 / 1 | 5 / 1 / 0 | 5 / 1 / 0 | 5 / 1 / 0 | 4 / 2 / 0 | 2 / 4 / 0 |
| | RF_Tuned | 4 / 1 / 1 | 3 / 2 / 1 | 6 / 0 / 0 | 3 / 2 / 1 | 6 / 0 / 0 | 3 / 3 / 0 |
| | NB | 2 / 4 / 0 | 2 / 4 / 0 | 3 / 3 / 0 | 2 / 4 / 0 | 5 / 1 / 0 | 4 / 2 / 0 |
| | LR | 0 / 6 / 0 | 0 / 6 / 0 | 0 / 6 / 0 | 0 / 6 / 0 | 0 / 6 / 0 | 5 / 1 / 0 |
| | | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large |
| | Dummy | 0 / 0 / 6 | 0 / 0 / 6 | 0 / 0 / 1 | 0 / 0 / 6 | 0 / 0 / 1 | 0 / 0 / 0 |
| | SVM | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 1 | 0 / 0 / 1 | 0 / 0 / 3 | 0 / 0 / 6 |
| | SVM_Tuned | 0 / 0 / 3 | 0 / 0 / 3 | 0 / 0 / 4 | 0 / 0 / 3 | 0 / 0 / 2 | 0 / 0 / 1 |
| | RF | 0 / 0 / 4 | 1 / 0 / 4 | 0 / 0 / 5 | 1 / 0 / 4 | 0 / 0 / 4 | 0 / 0 / 2 |
| | RF_Tuned | 0 / 0 / 4 | 0 / 0 / 3 | 0 / 0 / 6 | 0 / 0 / 3 | 0 / 0 / 6 | 0 / 0 / 3 |
| | NB | 0 / 0 / 2 | 0 / 0 / 2 | 0 / 0 / 3 | 0 / 0 / 2 | 0 / 0 / 5 | 0 / 0 / 4 |
| | LR | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 5 |
| Hive | | F1 win/loss/tie | G-measure win/loss/tie | MCC win/loss/tie | Balance win/loss/tie | AUC win/loss/tie | FPR win/loss/tie |
| | Dummy | 4 / 1 / 1 | 6 / 0 / 0 | 0 / 6 / 0 | 6 / 0 / 0 | 1 / 5 / 0 | 0 / 6 / 0 |
| | SVM | 0 / 6 / 0 | 0 / 6 / 0 | 1 / 5 / 0 | 0 / 6 / 0 | 3 / 3 / 0 | 6 / 0 / 0 |
| | SVM_Tuned | 3 / 3 / 0 | 4 / 2 / 0 | 4 / 2 / 0 | 4 / 2 / 0 | 2 / 4 / 0 | 1 / 5 / 0 |
| | RF | 6 / 0 / 0 | 5 / 1 / 0 | 5 / 1 / 0 | 5 / 1 / 0 | 4 / 1 / 1 | 2 / 4 / 0 |
| | RF_Tuned | 4 / 1 / 1 | 3 / 3 / 0 | 6 / 0 / 0 | 3 / 3 / 0 | 6 / 0 / 0 | 4 / 2 / 0 |
| | NB | 1 / 5 / 0 | 1 / 5 / 0 | 2 / 4 / 0 | 1 / 5 / 0 | 4 / 1 / 1 | 5 / 1 / 0 |
| | LR | 2 / 4 / 0 | 2 / 4 / 0 | 3 / 3 / 0 | 2 / 4 / 0 | 0 / 6 / 0 | 3 / 3 / 0 |
| | | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large |
| | Dummy | 1 / 0 / 3 | 0 / 0 / 6 | 0 / 0 / 0 | 0 / 0 / 6 | 0 / 0 / 1 | 0 / 0 / 0 |
| | SVM | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 3 | 0 / 0 / 6 |
| | SVM_Tuned | 0 / 0 / 3 | 0 / 0 / 4 | 0 / 0 / 4 | 0 / 0 / 4 | 0 / 0 / 2 | 0 / 0 / 1 |
| | RF | 0 / 0 / 6 | 0 / 0 / 5 | 0 / 0 / 5 | 0 / 0 / 5 | 0 / 0 / 4 | 0 / 0 / 2 |
| | RF_Tuned | 0 / 1 / 3 | 0 / 0 / 3 | 0 / 1 / 5 | 0 / 0 / 3 | 0 / 0 / 6 | 0 / 0 / 4 |
| | NB | 0 / 0 / 1 | 0 / 0 / 1 | 0 / 0 / 2 | 0 / 0 / 1 | 0 / 0 / 4 | 0 / 0 / 5 |
| | LR | 0 / 0 / 2 | 0 / 0 / 2 | 0 / 0 / 3 | 0 / 0 / 2 | 0 / 0 / 0 | 0 / 0 / 3 |

Table 4: The win-tie-loss results of the cross-project scenario.

| Dataset | F-measure win/loss/tie | G-measure win/loss/tie | MCC win/loss/tie | Dis2heaven win/loss/tie | AUC win/loss/tie | FPR win/loss/tie |
|---------|---------------------------|---------------------------|---------------------------|----------------------------|----------------------------|---------------------|
| JRuby | Dummy | 1 / 5 / 0 | 4 / 2 / 0 | 0 / 5 / 1 | 2 / 3 / 1 | 1 / 5 / 0 |
| | SVM | 0 / 6 / 0 | 0 / 6 / 0 | 0 / 5 / 1 | 0 / 6 / 0 | 3 / 3 / 0 |
| | SVM_Tuned | 2 / 4 / 0 | 1 / 5 / 0 | 2 / 4 / 0 | 1 / 5 / 0 | 0 / 6 / 0 |
| | RF | 5 / 1 / 0 | 5 / 1 / 0 | 5 / 1 / 0 | 5 / 1 / 0 | 3 / 2 / 1 |
| | RF_Tuned | 6 / 0 / 0 | 2 / 4 / 0 | 6 / 0 / 0 | 2 / 3 / 1 | 6 / 0 / 0 |
| | NB | 4 / 2 / 0 | 3 / 3 / 0 | 4 / 2 / 0 | 4 / 2 / 0 | 4 / 2 / 0 |
| | LR | 3 / 3 / 0 | 6 / 0 / 0 | 3 / 3 / 0 | 6 / 0 / 0 | 2 / 4 / 0 |
| | | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large |
| JRuby | Dummy | 0 / 0 / 1 | 0 / 1 / 3 | 0 / 0 / 0 | 0 / 0 / 2 | 0 / 0 / 1 |
| | SVM | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 3 |
| | SVM_Tuned | 0 / 0 / 2 | 0 / 0 / 1 | 0 / 0 / 2 | 0 / 0 / 1 | 0 / 0 / 0 |
| | RF | 0 / 0 / 5 | 0 / 0 / 5 | 0 / 0 / 5 | 0 / 0 / 5 | 0 / 0 / 5 |
| | RF_Tuned | 0 / 0 / 6 | 0 / 0 / 2 | 0 / 0 / 6 | 0 / 0 / 2 | 0 / 0 / 6 |
| | NB | 0 / 0 / 4 | 0 / 0 / 3 | 0 / 0 / 4 | 0 / 1 / 3 | 0 / 0 / 4 |
| | LR | 0 / 0 / 3 | 0 / 0 / 6 | 0 / 0 / 3 | 0 / 0 / 6 | 0 / 0 / 2 |
| | | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large |
| Lucene | | F-measure win/loss/tie | G-measure win/loss/tie | MCC win/loss/tie | Dis2heaven win/loss/tie | AUC win/loss/tie |
| | Dummy | 3 / 3 / 0 | 6 / 0 / 0 | 0 / 5 / 1 | 6 / 0 / 0 | 1 / 5 / 0 |
| | SVM | 0 / 6 / 0 | 0 / 6 / 0 | 0 / 5 / 1 | 0 / 6 / 0 | 3 / 3 / 0 |
| | SVM_Tuned | 4 / 2 / 0 | 3 / 3 / 0 | 4 / 2 / 0 | 3 / 3 / 0 | 2 / 4 / 0 |
| | RF | 5 / 1 / 0 | 5 / 1 / 0 | 5 / 1 / 0 | 5 / 1 / 0 | 4 / 2 / 0 |
| | RF_Tuned | 6 / 0 / 0 | 4 / 2 / 0 | 6 / 0 / 0 | 4 / 2 / 0 | 5 / 1 / 0 |
| | NB | 2 / 4 / 0 | 2 / 4 / 0 | 3 / 3 / 0 | 2 / 4 / 0 | 6 / 0 / 0 |
| | LR | 1 / 5 / 0 | 1 / 5 / 0 | 2 / 4 / 0 | 1 / 5 / 0 | 0 / 6 / 0 |
| Lucene | | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large |
| | Dummy | 0 / 0 / 3 | 0 / 0 / 6 | 0 / 0 / 0 | 0 / 0 / 6 | 0 / 0 / 1 |
| | SVM | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 3 |
| | SVM_Tuned | 0 / 0 / 4 | 0 / 0 / 3 | 0 / 0 / 4 | 0 / 0 / 3 | 0 / 0 / 2 |
| | RF | 0 / 0 / 5 | 0 / 0 / 5 | 0 / 0 / 5 | 0 / 0 / 5 | 0 / 0 / 4 |
| | RF_Tuned | 0 / 1 / 5 | 0 / 0 / 4 | 0 / 1 / 5 | 0 / 0 / 4 | 0 / 0 / 5 |
| | NB | 0 / 0 / 2 | 0 / 0 / 2 | 0 / 0 / 3 | 0 / 0 / 2 | 1 / 0 / 5 |
| | LR | 0 / 0 / 1 | 0 / 0 / 1 | 1 / 0 / 1 | 0 / 0 / 1 | 0 / 0 / 0 |
| Wicket | | F-measure win/loss/tie | G-measure win/loss/tie | MCC win/loss/tie | Dis2heaven win/loss/tie | AUC win/loss/tie |
| | Dummy | 3 / 3 / 0 | 6 / 0 / 0 | 1 / 4 / 1 | 6 / 0 / 0 | 1 / 5 / 0 |
| | SVM | 0 / 6 / 0 | 0 / 6 / 0 | 0 / 6 / 0 | 0 / 6 / 0 | 4 / 2 / 0 |
| | SVM_Tuned | 5 / 0 / 1 | 5 / 1 / 0 | 4 / 1 / 1 | 5 / 1 / 0 | 2 / 4 / 0 |
| | RF | 5 / 0 / 1 | 4 / 2 / 0 | 4 / 1 / 1 | 4 / 2 / 0 | 3 / 3 / 0 |
| | RF_Tuned | 4 / 2 / 0 | 3 / 3 / 0 | 6 / 0 / 0 | 3 / 3 / 0 | 5 / 1 / 0 |
| | NB | 0 / 6 / 0 | 0 / 6 / 0 | 1 / 4 / 1 | 1 / 5 / 0 | 6 / 0 / 0 |
| | LR | 2 / 4 / 0 | 2 / 4 / 0 | 3 / 3 / 0 | 2 / 4 / 0 | 0 / 6 / 0 |
| Wicket | | small/med/large | small/med/large | small/med/large | small/med/large | small/med/large |
| | Dummy | 0 / 0 / 3 | 0 / 0 / 6 | 1 / 0 / 0 | 0 / 0 / 6 | 0 / 0 / 1 |
| | SVM | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 4 |
| | SVM_Tuned | 0 / 0 / 5 | 1 / 0 / 4 | 0 / 0 / 4 | 1 / 0 / 4 | 0 / 0 / 2 |
| | RF | 1 / 0 / 4 | 0 / 0 / 4 | 0 / 0 / 4 | 0 / 0 / 4 | 0 / 0 / 3 |
| | RF_Tuned | 0 / 0 / 4 | 0 / 0 / 3 | 0 / 0 / 6 | 0 / 0 / 3 | 0 / 0 / 5 |
| | NB | 0 / 0 / 0 | 0 / 0 / 0 | 0 / 0 / 1 | 0 / 0 / 1 | 0 / 0 / 6 |
| | LR | 0 / 0 / 2 | 0 / 0 / 2 | 0 / 0 / 3 | 0 / 0 / 2 | 0 / 0 / 0 |

Table 5: The win-tie-loss results of the cross-project scenario.