

1 Experiment 2: After Perturbation (Experiment on Feature Data using Removal Edges Method)

DESCRIPTION: Experiment 2 is conducted on statistical tests between removal edges and normalized of removal feature.

1. Subsection 1.1 describes statistical tests for classification based the removal edges feature compare to the normalized of removal edges. The removal edges feature consists of Netpro2VecMetgraphs, Netpro2VecNDD, Netpro2VecTM1, Netpro2VecTM2, Netpro2VecNDD+TM1, Netpro2VecNDD+TM1+TM2, Graph2Vec, GL2Vec, FeatherGraph, and SF after randomly deleted 10% Met-graph edges. Meanwhile, normalized of removal edges refer to all removal edges features data that have been normalized using the min-max method, ensuring that feature values fall within the interval $[0,1]$.
2. In Subsection 1.1, we carry out statistical tests, including accuracy, precision, recall, and F1-score from all models-based graph embeddings.
3. Following Table 1a until Table 1d illustrate the test results.
4. Section 1.2 presents Figure 1a until Figure 1d as visualization of the statistical test results

RESUME: The comparison resume is based on the percentage difference of removal edges feature compare to the normalized of removal edges. Rely on the accuracy, precision, recall, and F1-score, we describe the best and the lowest percentage difference as follow:

1. The best percentage difference of accuracies are GCNs, DT, GNB, and RF with percentage difference of original compare to their normalized feature that is about 0.000%. Meanwhile the lowest is in non linear SVM (SVMnl) that is about 2.570%.
2. The best percentage difference of precisions are in GCNs, GNB, DT, and RF about 0.000%, meanwhile the lowest is in SVMnl that is about 3.352%.
3. The best percentage difference of recall are found in all classification models that is about 0.000%.
4. The best percentage difference of F1-score are also found in all classification models that is about 0.000%

CONCLUSION: Based on the statistical tests analyzing the effect of removal edges feature compare to the normalized of removal edges, we conclude that the best-performing model are in GCNs and DT, which are defending 0.000% percentage difference of accuracy, precision, recall, and F1-score. This is followed by GNB and RF, which are also defending 0.000% percentage difference of recall, and F1-score, except for accuracy. Finally we found SVMl and SVMnl which are just consistent in defending 0.000% percentage difference of recall and F1-Score.

1.1 Classification based removed Edges Vs Normalized of Removal Edges

Table 1: Comparison between removed Edges Vs Normalized Features

(a) Accuracy

| Accuracy | | | | |
|----------|---------|---------------|------------|------------------|
| Rank | Models: | Removed Edges | Normalized | Percentage diff. |
| 1 | GCNs | 1 | 1 | 0.000 |
| 2 | SVML | 0.97 | 0.978 | 0.825 |
| 3 | KNN | 0.958 | 0.963 | 0.522 |
| 4 | DT | 0.938 | 0.938 | 0.000 |
| 5 | RF/GNB | 0.933 | 0.935 | 0.214 |
| 6 | GNB/RF | 0.933 | 0.933 | 0.000 |
| 7 | SVMnl | 0.895 | 0.918 | 2.570 |

(b) Precision

| Precision | | | | |
|-----------|---------|---------------|------------|------------------|
| Rank | Models: | Removed Edges | Normalized | Percentage diff. |
| 1 | GCNs | 1 | 1 | 0.000 |
| 2 | SVML | 0.974 | 0.979 | 0.513 |
| 3 | KNN | 0.956 | 0.967 | 1.151 |
| 4 | GNB | 0.947 | 0.947 | 0.000 |
| 5 | DT | 0.946 | 0.946 | 0.000 |
| 6 | RF | 0.936 | 0.936 | 0.000 |
| 7 | SVMnl | 0.895 | 0.925 | 3.352 |

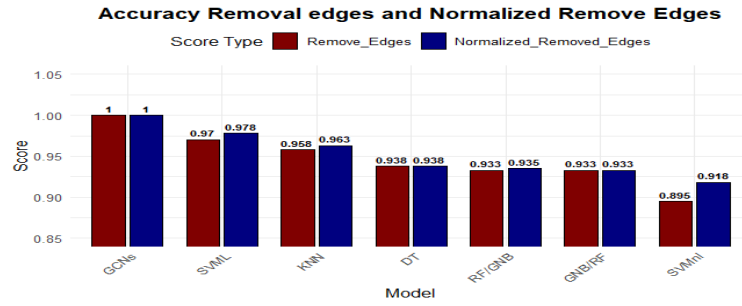
(c) Recall

| Recall | | | | |
|--------|---------|---------------|------------|------------------|
| Rank | Models: | Removed Edges | Normalized | Percentage diff. |
| 1 | GCNs | 1 | 1 | 0.000 |
| 2 | SVML | 0.967 | 0.967 | 0.005 |
| 3 | KNN | 0.957 | 0.957 | 0.000 |
| 4 | GNB/DT | 0.933 | 0.933 | 0.000 |
| 5 | RF/GNB | 0.931 | 0.931 | 0.000 |
| 6 | DT/RF | 0.931 | 0.931 | 0.000 |
| 7 | SVMnl | 0.897 | 0.897 | 0.000 |

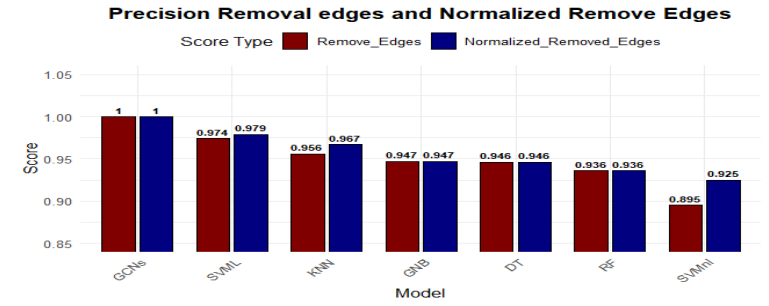
(d) F1-Score

| F1-Score | | | | |
|----------|---------|---------------|------------|------------------|
| Rank | Models: | Removed Edges | Normalized | Percentage diff. |
| 1 | GCNs | 1 | 1 | 0.000 |
| 2 | SVML | 0.969 | 0.969 | 0.000 |
| 3 | KNN | 0.957 | 0.957 | 0.000 |
| 4 | DT | 0.937 | 0.937 | 0.000 |
| 5 | GNB | 0.93 | 0.93 | 0.000 |
| 6 | RF | 0.927 | 0.927 | 0.000 |
| 7 | SVMnl | 0.887 | 0.887 | 0.000 |

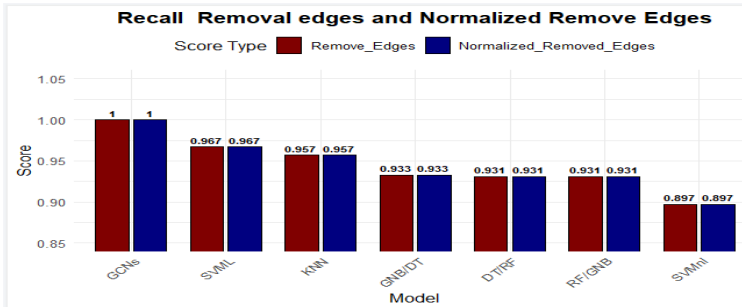
1.2 Figure of Statistical Tests Result



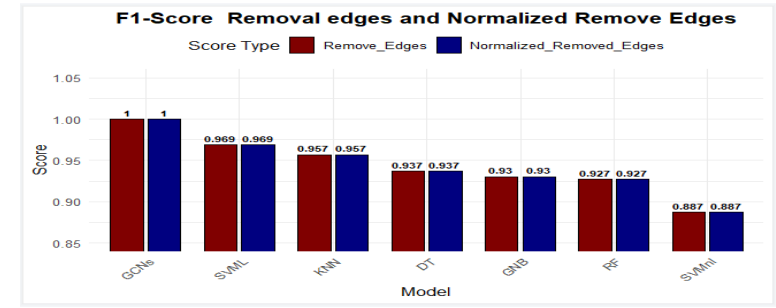
(a) Accuracy



(b) Precision



(c) Recall



(d) F1-score

Figure 1: Plot between removal edges and normalized of removal edges