# Output tables for the test of Multiple comparisons.

June 12, 2017

## 1 Average rankings of Friedman test

Average ranks obtained by applying the Friedman procedure

| Algorithm | Ranking |
|---|---|
| Base | 4.8594 |
| ADASYN | 5.2812 |
| SMOTE | 4.0625 |
| Bord | 3.5625 |
| NCL | 4.1719 |
| SMOTE+TL | 4 |
| SMOTE+ENN | 4.25 |
| CCR | 5.8125 |

Table 1: Average Rankings of the algorithms

Friedman statistic considering reduction performance (distributed according to chi-square with 7 degrees of freedom: 21.080729.

P-value computed by Friedman Test: 0.0036524865729630207.

## 2 Post hoc comparisons

Results achieved on post hoc comparisons for $\alpha = 0.05$, $\alpha = 0.10$ and adjusted p-values.

### 2.1 P-values for $\alpha = 0.05$

| $i$ | algorithms | $z = (R_0 - R_i)/SE$ | $p$ | Shaffer |
|---|---|---|---|---|
| 28 | Bord vs. CCR | 3.674235 | 0.000239 | 0.001786 |
| 27 | SMOTE+TL vs. CCR | 2.9598 | 0.003078 | 0.002381 |
| 26 | SMOTE vs. CCR | 2.857738 | 0.004267 | 0.002381 |
| 25 | ADASYN vs. Bord | 2.806707 | 0.005005 | 0.002381 |
| 24 | NCL vs. CCR | 2.679129 | 0.007381 | 0.002381 |
| 23 | SMOTE+ENN vs. CCR | 2.551552 | 0.010724 | 0.002381 |
| 22 | Base vs. Bord | 2.117788 | 0.034193 | 0.002381 |
| 21 | ADASYN vs. SMOTE+TL | 2.092272 | 0.036414 | 0.002381 |
| 20 | ADASYN vs. SMOTE | 1.99021 | 0.046568 | 0.0025 |
| 19 | ADASYN vs. NCL | 1.811602 | 0.070048 | 0.002632 |
| 18 | ADASYN vs. SMOTE+ENN | 1.684024 | 0.092177 | 0.002778 |
| 17 | Base vs. CCR | 1.556447 | 0.119602 | 0.002941 |
| 16 | Base vs. SMOTE+TL | 1.403353 | 0.160511 | 0.003125 |
| 15 | Base vs. SMOTE | 1.301291 | 0.193159 | 0.003333 |
| 14 | Base vs. NCL | 1.122683 | 0.261572 | 0.003571 |
| 13 | Bord vs. SMOTE+ENN | 1.122683 | 0.261572 | 0.003846 |
| 12 | Base vs. SMOTE+ENN | 0.995105 | 0.319685 | 0.004167 |
| 11 | Bord vs. NCL | 0.995105 | 0.319685 | 0.004545 |
| 10 | ADASYN vs. CCR | 0.867528 | 0.385653 | 0.005 |
| 9 | SMOTE vs. Bord | 0.816497 | 0.414216 | 0.005556 |
| 8 | Bord vs. SMOTE+TL | 0.714435 | 0.474959 | 0.00625 |
| 7 | Base vs. ADASYN | 0.688919 | 0.490874 | 0.007143 |
| 6 | SMOTE+TL vs. SMOTE+ENN | 0.408248 | 0.683091 | 0.008333 |
| 5 | SMOTE vs. SMOTE+ENN | 0.306186 | 0.759463 | 0.01 |
| 4 | NCL vs. SMOTE+TL | 0.280671 | 0.778963 | 0.0125 |
| 3 | SMOTE vs. NCL | 0.178609 | 0.858245 | 0.016667 |
| 2 | NCL vs. SMOTE+ENN | 0.127578 | 0.898483 | 0.025 |
| 1 | SMOTE vs. SMOTE+TL | 0.102062 | 0.918707 | 0.05 |

Table 2: P-values Table for $\alpha = 0.05$

Shaffer's procedure rejects those hypotheses that have an unadjusted p-value $\leq 0.001786$.

## 2.2 P-values for $\alpha = 0.10$

| $i$ | algorithms | $z = (R_0 - R_i)/SE$ | $p$ | Shaffer |
|---|---|---|---|---|
| 28 | Bord vs. CCR | 3.674235 | 0.000239 | 0.003571 |
| 27 | SMOTE+TL vs. CCR | 2.9598 | 0.003078 | 0.004762 |
| 26 | SMOTE vs. CCR | 2.857738 | 0.004267 | 0.004762 |
| 25 | ADASYN vs. Bord | 2.806707 | 0.005005 | 0.004762 |
| 24 | NCL vs. CCR | 2.679129 | 0.007381 | 0.004762 |
| 23 | SMOTE+ENN vs. CCR | 2.551552 | 0.010724 | 0.004762 |
| 22 | Base vs. Bord | 2.117788 | 0.034193 | 0.004762 |
| 21 | ADASYN vs. SMOTE+TL | 2.092272 | 0.036414 | 0.004762 |
| 20 | ADASYN vs. SMOTE | 1.99021 | 0.046568 | 0.005 |
| 19 | ADASYN vs. NCL | 1.811602 | 0.070048 | 0.005263 |
| 18 | ADASYN vs. SMOTE+ENN | 1.684024 | 0.092177 | 0.005556 |
| 17 | Base vs. CCR | 1.556447 | 0.119602 | 0.005882 |
| 16 | Base vs. SMOTE+TL | 1.403353 | 0.160511 | 0.00625 |
| 15 | Base vs. SMOTE | 1.301291 | 0.193159 | 0.006667 |
| 14 | Base vs. NCL | 1.122683 | 0.261572 | 0.007143 |
| 13 | Bord vs. SMOTE+ENN | 1.122683 | 0.261572 | 0.007692 |
| 12 | Base vs. SMOTE+ENN | 0.995105 | 0.319685 | 0.008333 |
| 11 | Bord vs. NCL | 0.995105 | 0.319685 | 0.009091 |
| 10 | ADASYN vs. CCR | 0.867528 | 0.385653 | 0.01 |
| 9 | SMOTE vs. Bord | 0.816497 | 0.414216 | 0.011111 |
| 8 | Bord vs. SMOTE+TL | 0.714435 | 0.474959 | 0.0125 |
| 7 | Base vs. ADASYN | 0.688919 | 0.490874 | 0.014286 |
| 6 | SMOTE+TL vs. SMOTE+ENN | 0.408248 | 0.683091 | 0.016667 |
| 5 | SMOTE vs. SMOTE+ENN | 0.306186 | 0.759463 | 0.02 |
| 4 | NCL vs. SMOTE+TL | 0.280671 | 0.778963 | 0.025 |
| 3 | SMOTE vs. NCL | 0.178609 | 0.858245 | 0.033333 |
| 2 | NCL vs. SMOTE+ENN | 0.127578 | 0.898483 | 0.05 |
| 1 | SMOTE vs. SMOTE+TL | 0.102062 | 0.918707 | 0.1 |

Table 3: P-values Table for $\alpha = 0.10$

Shaffer's procedure rejects those hypotheses that have an unadjusted p-value $\leq 0.003571$.

## 2.3 Adjusted p-values

| i | hypothesis | unadjusted $p$ | $p_{Shaf}$ |
|---|---|---|---|
| 1 | Bord vs .CCR | 0.000239 | 0.00668 |
| 2 | SMOTE+TL vs .CCR | 0.003078 | 0.064646 |
| 3 | SMOTE vs .CCR | 0.004267 | 0.089601 |
| 4 | ADASYN vs .Bord | 0.005005 | 0.105107 |
| 5 | NCL vs .CCR | 0.007381 | 0.155009 |
| 6 | SMOTE+ENN vs .CCR | 0.010724 | 0.225213 |
| 7 | Base vs .Bord | 0.034193 | 0.718054 |
| 8 | ADASYN vs .SMOTE+TL | 0.036414 | 0.764697 |
| 9 | ADASYN vs .SMOTE | 0.046568 | 0.764697 |
| 10 | ADASYN vs .NCL | 0.070048 | 1.120764 |
| 11 | ADASYN vs .SMOTE+ENN | 0.092177 | 1.474832 |
| 12 | Base vs .CCR | 0.119602 | 1.913631 |
| 13 | Base vs .SMOTE+TL | 0.160511 | 2.568183 |
| 14 | Base vs .SMOTE | 0.193159 | 2.897381 |
| 15 | Base vs .NCL | 0.261572 | 3.400439 |
| 16 | Bord vs .SMOTE+ENN | 0.261572 | 3.400439 |
| 17 | Base vs .SMOTE+ENN | 0.319685 | 3.836221 |
| 18 | Bord vs .NCL | 0.319685 | 3.836221 |
| 19 | ADASYN vs .CCR | 0.385653 | 3.85653 |
| 20 | SMOTE vs .Bord | 0.414216 | 3.85653 |
| 21 | Bord vs .SMOTE+TL | 0.474959 | 3.85653 |
| 22 | Base vs .ADASYN | 0.490874 | 3.85653 |
| 23 | SMOTE+TL vs .SMOTE+ENN | 0.683091 | 4.098548 |
| 24 | SMOTE vs .SMOTE+ENN | 0.759463 | 4.098548 |
| 25 | NCL vs .SMOTE+TL | 0.778963 | 4.098548 |
| 26 | SMOTE vs .NCL | 0.858245 | 4.098548 |
| 27 | NCL vs .SMOTE+ENN | 0.898483 | 4.098548 |
| 28 | SMOTE vs .SMOTE+TL | 0.918707 | 4.098548 |

Table 4: Adjusted $p$-values