

Output tables for 1xN statistical comparisons.

June 6, 2025

1 Average rankings of Friedman test

Average ranks obtained by each method in the Friedman test.

Friedman statistic (distributed according to chi-square with 17 degrees of freedom): 342.757193.

P-value computed by Friedman Test: 0.

Iman and Davenport statistic (distributed according to F-distribution with 17 and 408 degrees of freedom): 100.023004.

P-value computed by Iman and Davenport Test: 0.

| Algorithm | Ranking |
|-------------------------|---------|
| BestCyclicAssignment | 13.12 |
| BestNearest | 7.1 |
| CLARA | 12.72 |
| CoefficientPropagation | 12.36 |
| CyclicAssignment | 14.84 |
| Farthest-First | 5.42 |
| KMEANS | 5.78 |
| NearestByCustomer | 6.88 |
| NearestByDepot | 10.68 |
| PAM | 1 |
| Parallel | 6.88 |
| RandomByElement | 18 |
| RandomSequentialCyclic | 15.96 |
| SequentialCyclic | 15.96 |
| Simplified | 5.88 |
| Sweep | 5.74 |
| ThreeCriteriaClustering | 4.92 |
| UPGMC | 7.76 |

Table 1: Average Rankings of the algorithms (Friedman)

2 Post hoc comparison (Friedman)

P-values obtained in by applying post hoc methods over the results of Friedman procedure.

| i | algorithm | $z = (R_0 - R_i)/SE$ | p | Holm | Hochberg | Hommel | Holland | Rom | Finner | Li |
|-----|-------------------------|----------------------|----------|------|----------|--------|----------|----------|----------|----------|
| 17 | RandomByElement | 11.258525 | 0 | | 0.002941 | | 0.003013 | 0.003094 | 0.003013 | 0.052135 |
| 16 | RandomSequentialCyclic | 9.907502 | 0 | | 0.003125 | | 0.003201 | 0.003288 | 0.006016 | 0.052135 |
| 15 | SequentialCyclic | 9.907502 | 0 | | 0.003333 | | 0.003414 | 0.003507 | 0.009011 | 0.052135 |
| 14 | CyclicAssignment | 9.165764 | 0 | | 0.003571 | | 0.003657 | 0.003757 | 0.011996 | 0.052135 |
| 13 | BestCyclicAssignment | 8.026666 | 0 | | 0.003846 | | 0.003938 | 0.004046 | 0.014973 | 0.052135 |
| 12 | CLARA | 7.76176 | 0 | | 0.004167 | | 0.004265 | 0.004383 | 0.017941 | 0.052135 |
| 11 | CoefficientPropagation | 7.523344 | 0 | | 0.004545 | | 0.004652 | 0.004782 | 0.020899 | 0.052135 |
| 10 | NearestByDepot | 6.410737 | 0 | | 0.005 | | 0.005116 | 0.00526 | 0.023849 | 0.052135 |
| 9 | UPGMC | 4.476919 | 0.000008 | | 0.005556 | | 0.005683 | 0.005844 | 0.02679 | 0.052135 |
| 8 | BestNearest | 4.039824 | 0.000053 | | 0.00625 | | 0.006391 | 0.006574 | 0.029722 | 0.052135 |
| 7 | NearestByCustomer | 3.894125 | 0.000099 | | 0.007143 | | 0.007301 | 0.007513 | 0.032645 | 0.052135 |
| 6 | Parallel | 3.894125 | 0.000099 | | 0.008333 | | 0.008512 | 0.008764 | 0.035559 | 0.052135 |
| 5 | Simplified | 3.231859 | 0.00123 | | 0.01 | | 0.010206 | 0.010515 | 0.038465 | 0.052135 |
| 4 | KMEANS | 3.165632 | 0.001547 | | 0.0125 | | 0.012741 | 0.013109 | 0.041362 | 0.052135 |
| 3 | Sweep | 3.139142 | 0.001694 | | 0.016667 | | 0.016952 | 0.016667 | 0.04425 | 0.052135 |
| 2 | Farthest-First | 2.927217 | 0.00342 | | 0.025 | | 0.025321 | 0.025 | 0.047129 | 0.052135 |
| 1 | ThreeCriteriaClustering | 2.596083 | 0.009429 | | 0.05 | | 0.05 | 0.05 | 0.05 | 0.05 |

Table 2: Post Hoc comparison Table for $\alpha = 0.05$ (FRIEDMAN)

Bonferromi-Dunn's procedure rejects those hypotheses that have an unadjusted p-value ≤ 0.002941 .

Hochberg's procedure rejects those hypotheses that have an unadjusted p-value ≤ 0.05 .

Hommel's procedure rejects all hypotheses.

Rom's procedure rejects those hypotheses that have an unadjusted p-value ≤ 0.05 .

Li's procedure rejects those hypotheses that have an unadjusted p-value ≤ 0.05 .

3 Adjusted P-Values (Friedman)

Adjusted P-values obtained through the application of the post hoc methods (Friedman).

| i | algorithm | unadjusted p | p_{Bonf} | p_{Holm} | $p_{Hochberg}$ | p_{Hommel} |
|----|-------------------------|----------------|------------|------------|----------------|--------------|
| 1 | RandomByElement | 0 | 0 | 0 | 0 | 0 |
| 2 | RandomSequentialCyclic | 0 | 0 | 0 | 0 | 0 |
| 3 | SequentialCyclic | 0 | 0 | 0 | 0 | 0 |
| 4 | CyclicAssignment | 0 | 0 | 0 | 0 | 0 |
| 5 | BestCyclicAssignment | 0 | 0 | 0 | 0 | 0 |
| 6 | CLARA | 0 | 0 | 0 | 0 | 0 |
| 7 | CoefficientPropagation | 0 | 0 | 0 | 0 | 0 |
| 8 | NearestByDepot | 0 | 0 | 0 | 0 | 0 |
| 9 | UPGMC | 0.000008 | 0.000129 | 0.000068 | 0.000068 | 0.000068 |
| 10 | BestNearest | 0.000053 | 0.000909 | 0.000428 | 0.000428 | 0.000345 |
| 11 | NearestByCustomer | 0.000099 | 0.001675 | 0.00069 | 0.000591 | 0.000591 |
| 12 | Parallel | 0.000099 | 0.001675 | 0.00069 | 0.000591 | 0.000591 |
| 13 | Simplified | 0.00123 | 0.020908 | 0.006149 | 0.005083 | 0.00369 |
| 14 | KMEANS | 0.001547 | 0.026307 | 0.00619 | 0.005083 | 0.004642 |
| 15 | Sweep | 0.001694 | 0.028805 | 0.00619 | 0.005083 | 0.005083 |
| 16 | Farthest-First | 0.00342 | 0.058142 | 0.00684 | 0.00684 | 0.00684 |
| 17 | ThreeCriteriaClustering | 0.009429 | 0.160298 | 0.009429 | 0.009429 | 0.009429 |

Table 3: Adjusted p -values (FRIEDMAN) (I)

| i | algorithm | unadjusted p | $p_{Holland}$ | p_{Rom} | p_{Finner} | p_L |
|----|-------------------------|----------------|---------------|-----------|--------------|----------|
| 1 | RandomByElement | 0 | 0 | 0 | 0 | 0 |
| 2 | RandomSequentialCyclic | 0 | 0 | 0 | 0 | 0 |
| 3 | SequentialCyclic | 0 | 0 | 0 | 0 | 0 |
| 4 | CyclicAssignment | 0 | 0 | 0 | 0 | 0 |
| 5 | BestCyclicAssignment | 0 | 0 | 0 | 0 | 0 |
| 6 | CLARA | 0 | 0 | 0 | 0 | 0 |
| 7 | CoefficientPropagation | 0 | 0 | 0 | 0 | 0 |
| 8 | NearestByDepot | 0 | 0 | 0 | 0 | 0 |
| 9 | UPGMC | 0.000008 | 0.000068 | 0.000065 | 0.000014 | 0.000000 |
| 10 | BestNearest | 0.000053 | 0.000428 | 0.000407 | 0.000091 | 0.000000 |
| 11 | NearestByCustomer | 0.000099 | 0.00069 | 0.000562 | 0.000152 | 0.000000 |
| 12 | Parallel | 0.000099 | 0.00069 | 0.000562 | 0.000152 | 0.000000 |
| 13 | Simplified | 0.00123 | 0.006134 | 0.005083 | 0.001608 | 0.001000 |
| 14 | KMEANS | 0.001547 | 0.006175 | 0.005083 | 0.001879 | 0.001000 |
| 15 | Sweep | 0.001694 | 0.006175 | 0.005083 | 0.00192 | 0.001000 |
| 16 | Farthest-First | 0.00342 | 0.006829 | 0.00684 | 0.003633 | 0.003000 |
| 17 | ThreeCriteriaClustering | 0.009429 | 0.009429 | 0.009429 | 0.009429 | 0.009000 |

Table 4: Adjusted p -values (FRIEDMAN) (II)