Tukey post-hoc test

 # Cognitive variables actual values

```
$pvt_reaction_time
  Tukey multiple comparisons of means
    95% family-wise confidence level

$`as.factor(cluster)`
          diff           lwr         upr       p adj
2-1 -0.08578629 -0.122061992 -0.04951058 0.0000002
3-1 -0.06956511 -0.110930099 -0.02820012 0.0002071
4-1  0.04445552 -0.006461266  0.09537230 0.1081343
3-2  0.01622118 -0.020762294  0.05320465 0.6563956
4-2  0.13024180  0.082815718  0.17766789 0.0000000
4-3  0.11402063  0.062597194  0.16544406 0.0000010
```
Significant differences between:

-   C1 and C4 have significantly slower reaction times than C2 and C3

```
$nback_miss_1
  Tukey multiple comparisons of means
    95% family-wise confidence level

$`as.factor(cluster)`
        diff        lwr       upr      p adj
2-1 -5.231237 -8.9132304 -1.549244 0.0021132
3-1 -1.246324 -5.4448803  2.952233 0.8621712
4-1  3.816176 -1.3518897  8.984243 0.2190899
3-2  3.984914  0.2310822  7.738745 0.0332465
4-2  9.047414  4.2336543 13.861173 0.0000312
4-3  5.062500 -0.1569910 10.281991 0.0605568
```
Significant differences between:

-   C2 has fewer misses than C1/C3/C4

```
$nback_miss_2
  Tukey multiple comparisons of means
    95% family-wise confidence level

$`as.factor(cluster)`
        diff        lwr       upr      p adj
2-1 -4.081136 -6.798489 -1.363783 0.0010521
3-1  1.533088 -1.565494  4.631671 0.5636596
4-1  2.720588 -1.093503  6.534680 0.2464985
3-2  5.614224  2.843854  8.384595 0.0000072
4-2  6.801724  3.249115 10.354333 0.0000221
4-3  1.187500 -2.664544  5.039544 0.8483325
```
Significant differences between:

-   C2 has significantly fewer misses than C1/C3/C4

```
$tmt_a_time
  Tukey multiple comparisons of means
    95% family-wise confidence level

$`as.factor(cluster)`
        diff         lwr       upr      p adj
2-1 -6.41931 -11.2270158 -1.611605 0.0042911
3-1  5.01750  -0.4647005 10.499700 0.0846176
4-1 10.74750   3.9993777 17.495622 0.0004691
3-2 11.43681   6.5353030 16.338318 0.0000003
4-2 17.16681  10.8813185 23.452302 0.0000000
4-3  5.73000  -1.0852695 12.545269 0.1295358
```
Significant differences between:

-   C1, C3 and C4 have a significantly longer completion time than C2

- C4 has a significantly longer completion time than C1

C2 perfoming better(best) (shorter time) and C4 performing worse (longer time)

```
$tmt_b_time
  Tukey multiple comparisons of means
    95% family-wise confidence level

$`as.factor(cluster)`
         diff        lwr       upr      p adj
2-1 -3.565822 -17.016576  9.884933 0.8972061
3-1 20.666140   5.328318 36.003962 0.0038863
4-1 41.836765  22.957211 60.716318 0.0000010
3-2 24.231961  10.518773 37.945150 0.0000926
4-2 45.402586  27.817357 62.987816 0.0000000
4-3 21.170625   2.103210 40.238040 0.0237167
```
Significant differences between:

- C3 and C4 have a significantly longer completion time than C1 and C2

- C4 has a longer completion time than C3

C4 has the longest completion times overall, followed by C3. No significant differences between C1 and C2.

```
$tmt_diff
  Tukey multiple comparisons of means
    95% family-wise confidence level

$`as.factor(cluster)`
         diff        lwr      upr      p adj
2-1  2.853489 -9.8423456 15.54932 0.9340371
3-1 15.648640  1.1716485 30.12563 0.0291140
4-1 31.089265 13.2693203 48.90921 0.0001147
3-2 12.795151 -0.1483888 25.73869 0.0538206
4-2 28.235776 11.6375120 44.83404 0.0001728
4-3 15.440625 -2.5566366 33.43789 0.1177839
```
Significant differences between:

- C3 and C4 have a larger tmt_diff than C1

- C4 has larger tmt_diff than C2

- C3 has a borderline significantly larger tmt_diff than C2 (p=.0538)

C4 has the largest tmt_diff overall, followed by C3. No significant difference between C1 and C2.

 # Cognitive variables actual values – WithPCS

```
> tukey_results_withPCS
$pvt_reaction_time
  Tukey multiple comparisons of means
    95% family-wise confidence level

$`as.factor(withPCS_data$cluster)`
          diff         lwr         upr      p adj
2-1 -0.09151648 -0.15308321 -0.02994975 0.0015539
3-1 -0.07562839 -0.13303966 -0.01821712 0.0056594
4-1  0.03408476 -0.03453483  0.10270435 0.5481039
3-2  0.01588808 -0.04567864  0.07745481 0.8993494
4-2  0.12560124  0.05346902  0.19773345 0.0001985
4-3  0.10971315  0.04109356  0.17833274 0.0006354
```
Significant differences between:

- WithPCS: C2 and C3 have lower reaction time compared to C1 and C4

```
$nback_miss_1
  Tukey multiple comparisons of means
    95% family-wise confidence level

$`as.factor(withPCS_data$cluster)`
          diff        lwr       upr      p adj
2-1 -2.1538462 -7.5331982  3.225506 0.7069502
3-1 -0.4615385 -5.4778101  4.554733 0.9946249
4-1  4.5604396 -1.4351518 10.556031 0.1907776
3-2  1.6923077 -3.6870443  7.071660 0.8330410
4-2  6.7142857  0.4117812 13.016790 0.0329792
4-3  5.0219780 -0.9736133 11.017569 0.1284298
```

Significant differences between:

- WithPCS: C4 has more misses than C2

```
$nback_miss_2
  Tukey multiple comparisons of means
    95% family-wise confidence level

$`as.factor(withPCS_data$cluster)`
          diff           lwr       upr      p adj
2-1 -2.953846 -6.406693012  0.4990007 0.1165725
3-1  1.692308 -1.527488605  4.9121040 0.5006464
4-1  3.846154 -0.002238804  7.6945465 0.0501812
3-2  4.646154  1.193306988  8.0990007 0.0045828
4-2  6.800000  2.754608892 10.8453911 0.0003262
4-3  2.153846 -1.694546497  6.0022388 0.4461893
```

Significant differences between:

- WithPCS: C3 and C4 have more misses than C2

- WithPCS: C4 shows a borderline significant increase in misses compared to C1

```
$tmt_a_time
  Tukey multiple comparisons of means
    95% family-wise confidence level

$`as.factor(withPCS_data$cluster)`
          diff         lwr       upr      p adj
2-1 -6.001231 -13.289150  1.286689 0.1384971
3-1  4.920769  -1.875251 11.716789 0.2272833
4-1  9.909341   1.786543 18.032138 0.0114840
3-2 10.922000   3.634081 18.209919 0.0014120
4-2 15.910571   7.371970 24.449173 0.0000718
4-3  4.988571  -3.134226 13.111369 0.3645171
```

Significant differences between:

- WithPCS: C4 longer time compared to C1 and C2

- WithPCS: C3 longer time compared to C2

```
$tmt_b_time
  Tukey multiple comparisons of means
    95% family-wise confidence level

$`as.factor(withPCS_data$cluster)`
          diff         lwr       upr      p adj
2-1 -4.254308 -24.6613495 16.15273 0.9434081
3-1 18.397692  -0.6319723 37.42736 0.0613105
4-1 44.746264  22.0014642 67.49106 0.0000299
3-2 22.652000   2.2449582 43.05904 0.0245488
4-2 49.000571  25.0914701 72.90967 0.0000149
4-3 26.348571   3.6037718 49.09337 0.0176636
```

Significant differences between:

- WithPCS: C4 longer time compared to C1,C2 and C3

- WithPCS: C3 longer time compared to C2

- WithPCS: Borderline significant difference between C3 and C1

```
$tmt_diff
  Tukey multiple comparisons of means
    95% family-wise confidence level

$`as.factor(withPCS_data$cluster)`
         diff        lwr       upr     p adj
2-1  1.746923 -17.5484798 21.04233 0.9948749
3-1 13.476923  -4.5161329 31.46998 0.2018859
4-1 34.836923  13.3311078 56.34274 0.0005362
3-2 11.730000  -7.5654029 31.02540 0.3734535
4-2 33.090000  10.4833063 55.69669 0.0018562
4-3 21.360000  -0.1458153 42.86582 0.0521481
```

Significant differences between:

- WithPCS: C4 has higher tmt_diff compared to C1 and C2

- WithPCS: Borderline significant difference between C4 and C3

Cognitive variables actual values - WithoutPCS

```
> tukey_results_withoutPCS
$pvt_reaction_time
  Tukey multiple comparisons of means
    95% family-wise confidence level

$`as.factor(withoutPCS_data$cluster)`
           diff         lwr         upr     p adj
2-1 -0.058896296 -0.09496554 -0.02282705 0.0008321
3-1 -0.052786687 -0.10286368 -0.00270969 0.0362728
4-1  0.084180691  0.01087547  0.15748591 0.0203409
3-2  0.006109609 -0.03462409  0.04684330 0.9753364
4-2  0.143076987  0.07580751  0.21034647 0.0000300
4-3  0.136967378  0.06125807  0.21267668 0.0002520
```

Significant differences between:

- WithoutPCS: C2 and C3 significant shorter reaction time than C1

- WithoutPCS: C4 has significantly longer reaction time than C1,C2 and C3

```
$nback_miss_1
  Tukey multiple comparisons of means
    95% family-wise confidence level

$`as.factor(withoutPCS_data$cluster)`
         diff         lwr       upr     p adj
2-1 -6.592105 -11.583724 -1.600486 0.0067323
3-1 -4.750000 -11.680151  2.180151 0.2570190
4-1 -1.750000 -11.894702  8.394702 0.9633309
3-2  1.842105  -3.795027  7.479237 0.8026830
4-2  4.842105  -4.467312 14.151523 0.4887665
4-3  3.000000  -7.477404 13.477404 0.8571620
```

Significant differences between:

- WithoutPCS: C2 significantly more missings than C1

```
$nback_miss_2
  Tukey multiple comparisons of means
    95% family-wise confidence level

$`as.factor(withoutPCS_data$cluster)`
         diff         lwr       upr     p adj
2-1 -5.697368 -11.5133649  0.118628 0.0562946
3-1  1.250000  -6.8246816  9.324682 0.9730096
4-1 -3.750000 -15.5701236  8.070124 0.8161648
3-2  6.947368   0.3792508 13.515486 0.0354889
4-2  1.947368  -8.8995209 12.794258 0.9589843
4-3 -5.000000 -17.2077711  7.207771 0.6731786
```

Significant differences between:

- WithoutPCS: C3 more missings than C2

- Borderline C2 and C1

```
$tmt_a_time
  Tukey multiple comparisons of means
    95% family-wise confidence level

$`as.factor(withoutPCS_data$cluster)`
         diff         lwr       upr      p adj
2-1 -5.415789 -13.7404105   2.908832 0.2987057
3-1  4.950000  -6.6075491  16.507549 0.6419691
4-1 14.930000  -1.9885196  31.848520 0.0970044
3-2 10.365789   0.9646334  19.766946 0.0270111
4-2 20.345789   4.8202912  35.871288 0.0071955
4-3  9.980000  -7.4933719  27.453372 0.4087842
```
Significant differences between:

- WithoutPCS: C3 and C4 significantly slower than C2

```
$tmt_b_time
  Tukey multiple comparisons of means
    95% family-wise confidence level

$`as.factor(withoutPCS_data$cluster)`
          diff         lwr       upr      p adj
2-1  -1.939474 -23.9245537 20.04561 0.9947401
3-1  29.993333  -0.5298149 60.51648 0.0553137
4-1  19.730000 -24.9513138 64.41131 0.6196556
3-2  31.932807   7.1046296 56.76098 0.0084334
4-2  21.669474 -19.3329119 62.67186 0.4752699
4-3 -10.263333 -56.4099958 35.88333 0.9261010
```
Significant differences between:

- WithoutPCS: C3 significantly slower than C2

 # Cognitive variables winsorized Data

```
$pvt_reaction_time_w
  Tukey multiple comparisons of means
    95% family-wise confidence level

$`as.factor(cluster)`
          diff         lwr         upr       p adj
2-1 -0.07410493 -0.098301878 -0.04990798 0.0000000
3-1 -0.05788375 -0.085475401 -0.03029210 0.0000035
4-1  0.04896256  0.014999587  0.08292554 0.0017700
3-2  0.01622118 -0.008447874  0.04089023 0.3150419
4-2  0.12306749  0.091432911  0.15470207 0.0000000
4-3  0.10684631  0.072545387  0.14114724 0.0000000
```
Significant differences between:

- C2 and C3 have significantly lower reaction times than C1

- C4 has higher reaction times than C1, C2, C3

```
$tmt_a_time_w
  Tukey multiple comparisons of means
    95% family-wise confidence level

$`as.factor(cluster)`
         diff         lwr       upr      p adj
2-1 -6.419310 -11.0300296 -1.808591 0.0026843
3-1  4.750391  -0.5071876 10.007969 0.0906829
4-1 10.533281   4.0616498 17.004913 0.0003413
3-2 11.169701   6.4690231 15.870379 0.0000002
4-2 16.952592  10.9246353 22.980548 0.0000000
```

```
4-3   5.782891   -0.7531367 12.318918 0.1011462
```
Significant differences between:

- C2 lower time than C1

- C4 has significantly higher time than C1 and C2

- C3 has significantly higher time than C2

```
$tmt_b_time_w
  Tukey multiple comparisons of means
    95% family-wise confidence level

$`as.factor(cluster)`
         diff        lwr       upr      p adj
2-1 -3.565822 -12.861532   5.729889 0.7435482
3-1 18.469733   7.869885 29.069582 0.0001171
4-1 30.163952  17.116441 43.211464 0.0000004
3-2 22.035555  12.558478 31.512632 0.0000003
4-2 33.729774  21.576759 45.882788 0.0000000
4-3 11.694219  -1.483122 24.871560 0.0995955
```
Significant differences between:

- C3 and C4 significantly higher time than C1 and C2

```
$tmt_diff_w
  Tukey multiple comparisons of means
    95% family-wise confidence level

$`as.factor(cluster)`
         diff       lwr      upr      p adj
2-1  2.853489 -6.124869 11.83185 0.8363185
3-1 13.719343  3.481371 23.95732 0.0041260
4-1 19.630671  7.028598 32.23274 0.0006422
3-2 10.865854  1.712322 20.01939 0.0135921
4-2 16.777182  5.039069 28.51530 0.0019660
4-3  5.911328 -6.816141 18.63880 0.6138830
```
Significant differences between:

- C3 and C4 higher differences than C1 and C2

 # Cognitive variables winsorized Data - WithPCS

```
> tukey_results_withPCS
$pvt_reaction_time_w
  Tukey multiple comparisons of means
    95% family-wise confidence level

$`as.factor(withPCS_data$cluster)`
          diff            lwr          upr      p adj
2-1 -0.07624085 -0.114234672 -0.03824704 0.0000214
3-1 -0.06035277 -0.095782187 -0.02492335 0.0002711
4-1  0.04116117 -0.001185086  0.08350742 0.0593959
3-2  0.01588808 -0.022105732  0.05388190 0.6782792
4-2  0.11740202  0.072888073  0.16191597 0.0000001
4-3  0.10151394  0.059167684  0.14386019 0.0000008
```
Significant differences between:

- WithPCS: C2 and C3 have lower reaction time than C1 and C4

```
$tmt_a_time_w
  Tukey multiple comparisons of means
    95% family-wise confidence level

$`as.factor(withPCS_data$cluster)`
         diff        lwr       upr      p adj
2-1 -6.001231 -12.855987  0.8535254 0.1043696
3-1  4.592019  -1.800074 10.9841123 0.2333638
4-1  9.664519   2.024507 17.3045317 0.0083088
```

```
3-2 10.593250    3.738494 17.4480061 0.0009753
4-2 15.665750    7.634647 23.6968532 0.0000344
4-3  5.072500   -2.567513 12.7125125 0.2973581
```
Significant differences between:

- WithPCS: C4 has higher TMT a time compared to C1 and C2

- WithPCS: C3 has higher TMT a time compared to C2

```
$tmt_b_time_w
  Tukey multiple comparisons of means
    95% family-wise confidence level

$`as.factor(withPCS_data$cluster)`
        diff        lwr       upr      p adj
2-1 -4.254308 -17.2885699  8.779954 0.8172798
3-1 17.469135   5.3146225 29.623647 0.0022797
4-1 31.405907  16.8784859 45.933327 0.0000057
3-2 21.723442   8.6891801 34.757704 0.0003666
4-2 35.660214  20.3891378 50.931291 0.0000013
4-3 13.936772  -0.5906487 28.464193 0.0641323
```
Significant differences between:

- WithPCS: C3 and C4 have higher time compared to C1 and C2

```
$tmt_diff_w
  Tukey multiple comparisons of means
    95% family-wise confidence level

$`as.factor(withPCS_data$cluster)`
        diff        lwr       upr      p adj
2-1  1.746923 -11.3867950 14.88064 0.9841865
3-1 12.877115   0.6298602 25.12437 0.0360914
4-1 21.741387   7.1031175 36.37966 0.0015688
3-2 11.130192  -2.0035257 24.26391 0.1217862
4-2 19.994464   4.6068643 35.38206 0.0064610
4-3  8.864272  -5.7739979 23.50254 0.3768724
```
Significant differences between:

- WithPCS: C3 and C4 have higher differences than C1

- WithPCS: C4 has higher differences than C2

Cognitive variables winsorized Data - WithoutPCS

```
> tukey_results_withoutPCS
$pvt_reaction_time_w
  Tukey multiple comparisons of means
    95% family-wise confidence level

$`as.factor(withoutPCS_data$cluster)`
            diff          lwr         upr      p adj
2-1 -0.058896296 -0.09496554 -0.02282705 0.0008321
3-1 -0.052786687 -0.10286368 -0.00270969 0.0362728
4-1  0.084180691  0.01087547  0.15748591 0.0203409
3-2  0.006109609 -0.03462409  0.04684330 0.9753364
4-2  0.143076987  0.07580751  0.21034647 0.0000300
4-3  0.136967378  0.06125807  0.21267668 0.0002520
```
Significant differences between:

- WithoutPCS: C4 has higher reaction time than C1, C2 and C3

- WithoutPCS: C1 has higher reaction time than C2 and C3

```
$tmt_a_time_w
  Tukey multiple comparisons of means
    95% family-wise confidence level

$`as.factor(withoutPCS_data$cluster)`
```

```
        diff       lwr       upr    p adj
2-1 -5.415789 -13.7404105   2.908832 0.2987057
3-1  4.950000  -6.6075491  16.507549 0.6419691
4-1 14.930000  -1.9885196  31.848520 0.0970044
3-2 10.365789   0.9646334  19.766946 0.0270111
4-2 20.345789   4.8202912  35.871288 0.0071955
4-3  9.980000  -7.4933719  27.453372 0.4087842
```

Significant differences between:

- WithoutPCS: C3 and C4 have higher completion time than C2

```
$tmt_b_time_w
  Tukey multiple comparisons of means
    95% family-wise confidence level

$`as.factor(withoutPCS_data$cluster)`
        diff       lwr       upr    p adj
2-1 -1.939474 -20.453302 16.57436 0.9912820
3-1 22.302917  -3.400894 48.00673 0.1050318
4-1 19.730000 -17.896526 57.35653 0.4819168
3-2 24.242390   3.334364 45.15042 0.0189721
4-2 21.669474 -12.858995 56.19794 0.3284997
4-3 -2.572917 -41.433426 36.28759 0.9977518
```

Significant differences between:

- WithoutPCS: C3 higher completion time than C2

Summary:

- C1 performed best everywhere except for tmt_diff

- C4 performed worst everywhere

- Always a significant difference between C1 and C4

- C3 significantly better in PVT reaction time compared to C1 (with and without winsorizing)

- No significant differences between C3 and C1 in tmtA time

- C1 significantly better in tmtB time compared to C3 (with and without winsorizing)