**INDICATOR 3**

| Treatment → | A | B | C | D | E | F | G | H |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Input Data → | 11.8944 103.277 83.235 22.5302 27.0259 29.1064 27.7339 27.7836 41.9953 47.9141 40.8817 88.7335 43.534 33.3515 66.3855 50.7976 85.7374 55.8073 70.5293 87.9505 65.1668 71.8726 75.4326 58.1552 145.058 71.0195 289.061 61.2039 165.008 116.445 84.8196 30.1006 | 22.5889 94.9214 72.899 25.8043 27.4843 33.6627 51.7913 57.2413 54.8466 44.4875 37.1851 86.4885 28.2461 60.1814 47.8476 43.5656 45.4581 110.303 82.2068 81.0155 147.646 85.2671 64.4281 45.0186 103.85 61.8314 170.156 58.1075 83.9798 163.183 48.6551 127.932 | 50.578 56.7231 65.1772 14.4156 44.901 25.2297 79.767 22.5915 66.4254 42.8784 16.1524 43.5227 64.8134 55.1437 122.565 26.3101 50.4965 60.3339 43.0989 65.3746 193.082 148.853 81.9362 72.1708 56.7303 71.4428 104.842 56.994 86.3713 137.475 234.16 39.1977 | 54.0459 83.9647 50.216 9.51872 39.7952 16.1861 67.0491 28.0475 8.61036 29.5952 61.5379 56.3726 30.0925 25.2579 74.6673 38.7189 30.0281 61.1184 57.2952 84.3403 59.3162 67.1109 54.5195 80.9303 38.5446 67.0045 216.167 92.106 352.861 104.484 72.6604 62.3655 | 42.8353 27.6836 55.6358 20.9634 54.1792 16.3512 22.0486 31.2625 30.0433 24.0977 28.9767 65.9297 64.277 42.4324 35.0934 42.436 29.179 37.976 53.9208 50.3828 96.1703 119.186 37.828 60.2715 66.837 51.156 242.467 24.2077 103.859 132.86 30.0345 73.6385 | 15.3409 34.7958 66.4835 20.1895 29.5303 28.6794 26.9496 6.08026 25.7785 24.9777 32.0675 30.8864 54.3267 44.7844 62.0988 12.1469 19.9634 35.6829 34.2586 70.7719 106.779 131.554 68.6203 78.2805 133.624 68.5989 107.498 50.6535 51.2989 97.3954 58.6378 75.9971 | 6.30394 20.804 80.5113 12.2228 13.9247 24.1943 35.3741 13.5299 12.0915 12.3816 12.5195 14.9512 76.445 22.1773 81.0086 31.6743 42.5313 10.4642 5.57293 29.3747 8.21875 41.2272 29.6903 38.2061 123.475 63.1309 181.258 3.80726 111.746 69.0159 24.0281 171.226 | 15.8809 81.0157 8.40902 3.49259 19.7846 13.0925 14.3284 12.4305 50.9323 13.4577 27.8022 65.5312 5.06866 46.3483 76.1731 3.42948 29.7357 66.8948 82.6622 14.854 193.551 73.3516 0.0 8.85952 35.4035 34.3731 0.0 68.2517 9.92478 134.598 66.8549 22.9622 |

**Descriptive statistics of the k=8 independent treatments:**

| **Treatment →** | **A** | **B** | **C** | **D** | **E** | **F** | **G** | **H** | **Pooled Total** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **observations N** | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 256 |
| **sum ∑xi** | 2,279.5469 | 2,268.2796 | 2,299.7532 | 2,174.5278 | 1,814.2199 | 1,704.7304 | 1,423.0867 | 1,299.4542 | 15,263.5986 |
| **mean ¯x** | 71.2358 | 70.8837 | 71.8673 | 67.9540 | 56.6944 | 53.2728 | 44.4715 | 40.6079 | 59.6234 |
| **sum of squares ∑x2i** | 248,896.0227 | 207,960.0409 | 240,090.1033 | 274,605.1538 | 163,917.0202 | 126,376.1951 | 130,066.1597 | 109,290.7090 | 1,501,201.4048 |
| **sample variance s2** | 2,790.6640 | 1,521.8034 | 2,413.3251 | 4,091.5261 | 1,969.7085 | 1,147.1095 | 2,154.1748 | 1,823.3081 | 2,318.1697 |
| **sample std. dev. s** | 52.8267 | 39.0103 | 49.1256 | 63.9650 | 44.3814 | 33.8690 | 46.4131 | 42.7002 | 48.1474 |
| **std. dev. of mean SE¯x** | 9.3385 | 6.8961 | 8.6843 | 11.3075 | 7.8456 | 5.9873 | 8.2048 | 7.5484 | 3.0092 |

**One-way ANOVA of your k=8 independent treatments:**

| source | sum of squares SS | degrees of freedom νν | mean square MS | F statistic | p-value |
| --- | --- | --- | --- | --- | --- |
| treatment | 35,873.0728 | 7 | 5,124.7247 | 2.2889 | 0.0282 |
| error | 555,260.2019 | 248 | 2,238.9524 |  |  |
| total | 591,133.2747 | 255 |  |  |  |

**Conclusion from Anova:**

The p-value corresponing to the F-statistic of one-way ANOVA is higher than 0.05, suggesting that the treatments are not significantly different for that level of significance. The Tukey HSD test, as well as other multiple comparison tests like Scheffe or Bonferroni, might not narrow down which of the pairs of treatments are significantly different. Even though your data does not suggest the presence of significatly different treatment pairs in one-way ANOVA, we proceed witht he multiple conparison tests. In some instances, a Bonferroni test of a small set of pairs might show significance, even though 1-way ANOVA suggests that there is too much noise and randomness in your data.

**Post-hoc Turkey HSD Test Calculator results:**

| treatments pair | Tukey HSD Q statistic | Tukey HSD p-value | Tukey HSD inferfence |
| --- | --- | --- | --- |
| A vs B | 0.0421 | 0.8999947 | insignificant |
| A vs C | 0.0755 | 0.8999947 | insignificant |
| A vs D | 0.3923 | 0.8999947 | insignificant |
| A vs E | 1.7384 | 0.8999947 | insignificant |
| A vs F | 2.1475 | 0.7707602 | insignificant |
| A vs G | 3.1997 | 0.3186405 | insignificant |
| A vs H | 3.6616 | 0.1649909 | insignificant |
| B vs C | 0.1176 | 0.8999947 | insignificant |
| B vs D | 0.3503 | 0.8999947 | insignificant |
| B vs E | 1.6964 | 0.8999947 | insignificant |
| B vs F | 2.1054 | 0.7883895 | insignificant |
| B vs G | 3.1576 | 0.3360050 | insignificant |
| B vs H | 3.6195 | 0.1758853 | insignificant |
| C vs D | 0.4678 | 0.8999947 | insignificant |
| C vs E | 1.8139 | 0.8999947 | insignificant |
| C vs F | 2.2230 | 0.7391430 | insignificant |
| C vs G | 3.2752 | 0.2892833 | insignificant |
| C vs H | 3.7371 | 0.1457739 | insignificant |
| D vs E | 1.3461 | 0.8999947 | insignificant |
| D vs F | 1.7551 | 0.8999947 | insignificant |
| D vs G | 2.8074 | 0.4941403 | insignificant |
| D vs H | 3.2692 | 0.2915570 | insignificant |
| E vs F | 0.4090 | 0.8999947 | insignificant |
| E vs G | 1.4613 | 0.8999947 | insignificant |
| E vs H | 1.9231 | 0.8647241 | insignificant |
| F vs G | 1.0522 | 0.8999947 | insignificant |
| F vs H | 1.5141 | 0.8999947 | insignificant |
| G vs H | 0.4619 | 0.8999947 | insignificant |

**Scheffé multiple comparison:**

|  |  |  |  |
| --- | --- | --- | --- |
| treatments pair | Scheffé TT-statistic | Scheffé p-value | Scheffé inferfence |
| A vs B | 0.0298 | 1.0000000 | insignificant |
| A vs C | 0.0534 | 1.0000000 | insignificant |
| A vs D | 0.2774 | 0.9999990 | insignificant |
| A vs E | 1.2293 | 0.9815509 | insignificant |
| A vs F | 1.5185 | 0.9401497 | insignificant |
| A vs G | 2.2625 | 0.6455932 | insignificant |
| A vs H | 2.5891 | 0.4628373 | insignificant |
| B vs C | 0.0831 | 1.0000000 | insignificant |
| B vs D | 0.2477 | 0.9999996 | insignificant |
| B vs E | 1.1995 | 0.9840211 | insignificant |
| B vs F | 1.4887 | 0.9461079 | insignificant |
| B vs G | 2.2328 | 0.6617537 | insignificant |
| B vs H | 2.5594 | 0.4793742 | insignificant |
| C vs D | 0.3308 | 0.9999967 | insignificant |
| C vs E | 1.2826 | 0.9764038 | insignificant |
| C vs F | 1.5719 | 0.9283501 | insignificant |
| C vs G | 2.3159 | 0.6161794 | insignificant |
| C vs H | 2.6425 | 0.4335347 | insignificant |
| D vs E | 0.9518 | 0.9961069 | insignificant |
| D vs F | 1.2411 | 0.9804939 | insignificant |
| D vs G | 1.9851 | 0.7856455 | insignificant |
| D vs H | 2.3117 | 0.6185153 | insignificant |
| E vs F | 0.2892 | 0.9999987 | insignificant |
| E vs G | 1.0333 | 0.9935067 | insignificant |
| E vs H | 1.3599 | 0.9671369 | insignificant |
| F vs G | 0.7440 | 0.9992028 | insignificant |
| F vs H | 1.0706 | 0.9919244 | insignificant |
| G vs H | 0.3266 | 0.9999970 | insignificant |

**Bonferroni and Holm results: all pairs simultaineously compared:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| treatments pair | Bonferroni and Holm TT-statistic | Bonferroni p-value | Bonferroni inferfence | Holm p-value | Holm inferfence |
| A vs B | 0.0298 | 27.3357931 | insignificant | 0.9762783 | insignificant |
| A vs C | 0.0534 | 26.8092307 | insignificant | 1.9149450 | insignificant |
| A vs D | 0.2774 | 21.8870352 | insignificant | 3.9083991 | insignificant |
| A vs E | 1.2293 | 6.1638404 | insignificant | 3.0819202 | insignificant |
| A vs F | 1.5185 | 3.6444900 | insignificant | 2.4730468 | insignificant |
| A vs G | 2.2625 | 0.6868463 | insignificant | 0.5641951 | insignificant |
| A vs H | 2.5891 | 0.2853277 | insignificant | 0.2751375 | insignificant |
| B vs C | 0.0831 | 26.1465019 | insignificant | 2.8014109 | insignificant |
| B vs D | 0.2477 | 22.5287264 | insignificant | 3.2183895 | insignificant |
| B vs E | 1.1995 | 6.4813841 | insignificant | 3.0092141 | insignificant |
| B vs F | 1.4887 | 3.8591229 | insignificant | 2.4808648 | insignificant |
| B vs G | 2.2328 | 0.7408052 | insignificant | 0.5820612 | insignificant |
| B vs H | 2.5594 | 0.3102525 | insignificant | 0.2880916 | insignificant |
| C vs D | 0.3308 | 20.7498619 | insignificant | 5.9285320 | insignificant |
| C vs E | 1.2826 | 5.6227879 | insignificant | 3.2130217 | insignificant |
| C vs F | 1.5719 | 3.2830491 | insignificant | 2.3450350 | insignificant |
| C vs G | 2.3159 | 0.5986206 | insignificant | 0.5344827 | insignificant |
| C vs H | 2.6425 | 0.2450836 | insignificant | 0.2450836 | insignificant |
| D vs E | 0.9518 | 9.5790175 | insignificant | 3.4210777 | insignificant |
| D vs F | 1.2411 | 6.0410143 | insignificant | 3.2362577 | insignificant |
| D vs G | 1.9851 | 1.3505788 | insignificant | 1.0129341 | insignificant |
| D vs H | 2.3117 | 0.6051961 | insignificant | 0.5187395 | insignificant |
| E vs F | 0.2892 | 21.6338759 | insignificant | 4.6358305 | insignificant |
| E vs G | 1.0333 | 8.4696029 | insignificant | 3.3273440 | insignificant |
| E vs H | 1.3599 | 4.9029736 | insignificant | 2.9768054 | insignificant |
| F vs G | 0.7440 | 12.8118380 | insignificant | 4.1180908 | insignificant |
| F vs H | 1.0706 | 7.9905691 | insignificant | 3.4245296 | insignificant |
| G vs H | 0.3266 | 20.8388192 | insignificant | 5.2097048 | insignificant |