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STA3024
03 November 2010

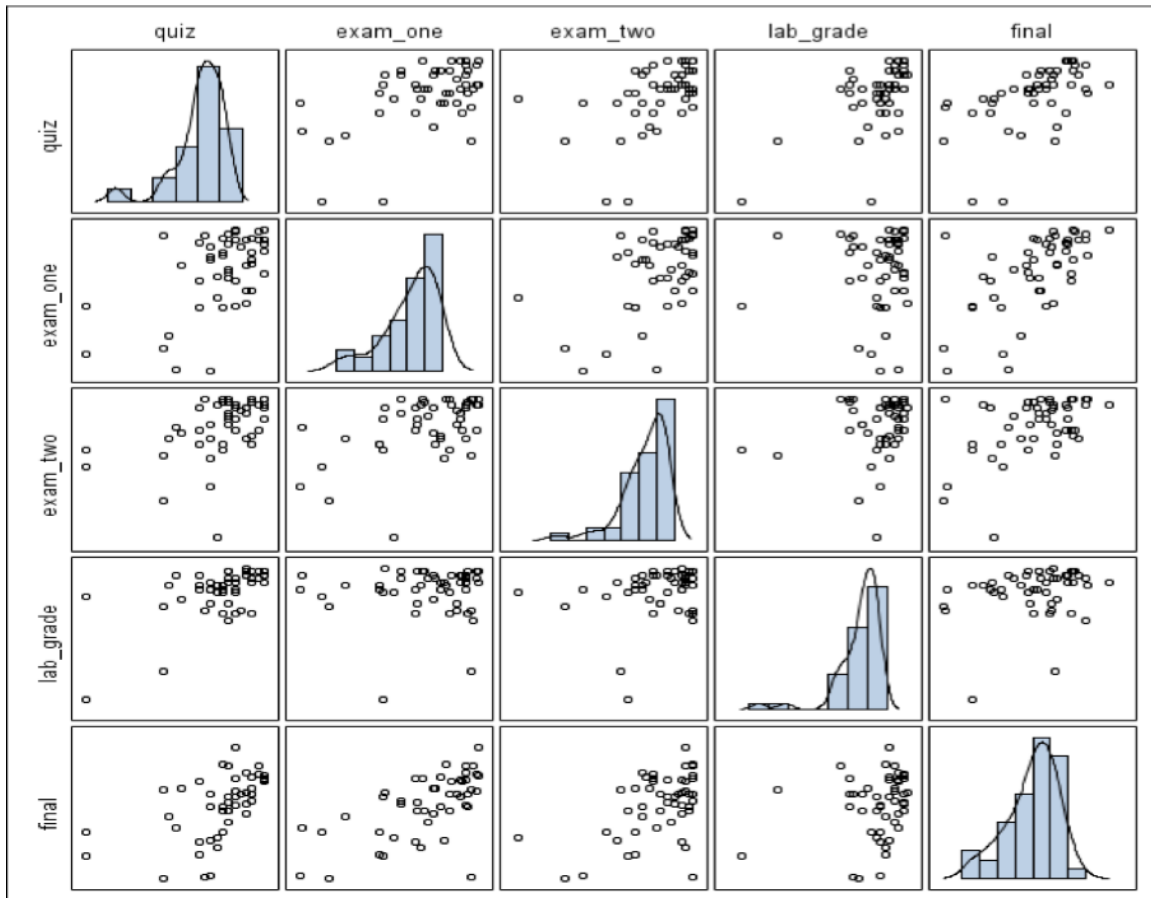
Assignment 5

1a.

The SAS System 17:52 Wednesday, November 3, 2010 1

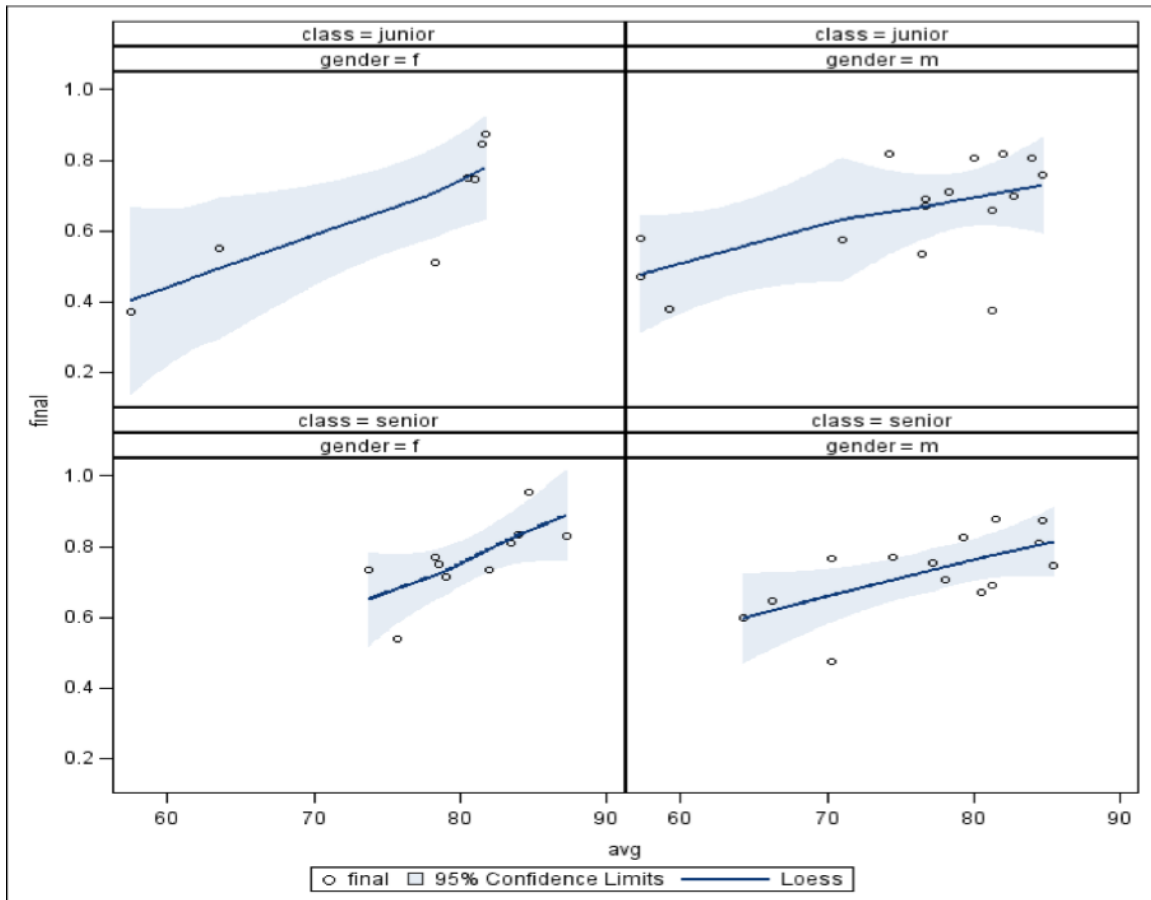
| Obs | ID | gender | class | quiz | exam_one | lab_ exam_two | grade | final | avg |
|-----|-----|--------|----------|------|----------|------------------|-------|-------|--------|
| 1 | air | f | senior | 1.00 | 0.93 | 0.93 | 0.98 | 0.810 | 0.9600 |
| 2 | aln | m | senior | 0.98 | 0.95 | 0.98 | 0.97 | 0.875 | 0.9700 |
| 3 | bam | m | senior | 0.78 | 0.63 | 0.84 | 0.95 | 0.475 | 0.8000 |
| 4 | bag | f | junior | 0.92 | 0.92 | 0.96 | 0.88 | 0.750 | 0.9200 |
| 5 | bes | f | senior | 0.90 | 1.00 | 0.98 | 0.96 | 0.955 | 0.9600 |
| 6 | bec | f | junior | 0.88 | 0.98 | 1.00 | 0.85 | 0.875 | 0.9275 |
| 7 | bej | m | junior | 0.82 | 0.86 | 0.86 | 0.94 | 0.690 | 0.8700 |
| 8 | bis | f | senior | 1.00 | 1.00 | 1.00 | 0.99 | 0.830 | 0.9975 |
| 9 | blc | m | senior | 1.00 | 0.95 | 0.97 | 0.96 | 0.810 | 0.9700 |
| 10 | boc | f | senior | 0.96 | 0.71 | 1.00 | 0.97 | 0.715 | 0.9100 |
| 11 | brm | f | senior | 0.90 | 0.64 | 0.93 | 0.93 | 0.735 | 0.8500 |
| 12 | cac | f | senior | 0.82 | 0.92 | 0.91 | 0.90 | 0.750 | 0.8875 |
| 13 | cot | m | senior | 0.68 | 0.50 | 0.86 | 0.95 | 0.645 | 0.7475 |
| 14 | crb | m | junior | 0.40 | 0.64 | 0.82 | 0.63 | 0.470 | 0.6225 |
| 15 | due | f | junior | 0.66 | 0.44 | 0.64 | 0.89 | 0.370 | 0.6575 |
| 16 | evr | m | junior | 0.90 | 0.99 | 0.98 | 0.97 | 0.760 | 0.9600 |
| 17 | fra | f | junior | 0.84 | 0.68 | 0.51 | 0.93 | 0.550 | 0.7400 |
| 18 | gaa | m | junior | 0.80 | 0.97 | 1.00 | 0.88 | 0.375 | 0.9125 |
| 19 | gid | m | senior | 0.88 | 0.80 | 0.99 | 0.99 | 0.670 | 0.9150 |
| 20 | glp | m | senior | 0.96 | 0.86 | 0.87 | 0.96 | 0.825 | 0.9125 |
| 21 | grf | m | senior | 0.72 | 0.83 | 0.88 | 0.91 | 0.770 | 0.8350 |
| 22 | grt | f | junior | 0.84 | 0.78 | 0.98 | 0.95 | 0.510 | 0.8875 |
| 23 | hat | f | senior | 0.96 | 0.84 | 0.84 | 0.97 | 0.770 | 0.9025 |
| 24 | hic | f | senior | 0.82 | 0.87 | 0.79 | 0.96 | 0.540 | 0.8600 |
| 25 | hot | m | senior | 0.94 | 0.65 | 0.97 | 1.00 | 0.755 | 0.8900 |
| 26 | jod | m | junior | 1.00 | 0.90 | 0.98 | 0.98 | 0.805 | 0.9650 |
| 27 | kem | m | junior | 0.78 | 0.76 | 0.97 | 0.94 | 0.535 | 0.8625 |
| 28 | krc | m | junior | 0.88 | 0.77 | 0.93 | 0.99 | 0.710 | 0.8925 |
| 29 | lak | f | junior | 0.96 | 0.89 | 1.00 | 0.87 | 0.745 | 0.9300 |
| 30 | lea | m | sophmore | 0.88 | 0.77 | 0.91 | 0.90 | 0.675 | 0.8650 |
| 31 | lls | m | junior | 1.00 | 0.79 | 1.00 | 0.99 | 0.820 | 0.9450 |
| 32 | mam | f | senior | 0.88 | 0.93 | 0.95 | 0.96 | 0.735 | 0.9300 |
| 33 | mej | m | senior | 0.96 | 0.96 | 0.99 | 0.99 | 0.745 | 0.9750 |
| 34 | met | m | senior | 0.66 | 0.97 | 0.80 | 0.71 | 0.765 | 0.7850 |
| 35 | mis | m | junior | 0.90 | 0.76 | 0.89 | 0.87 | 0.820 | 0.8550 |
| 36 | ngy | m | junior | 0.82 | 0.33 | 0.69 | 0.94 | 0.380 | 0.6950 |
| 37 | oaa | f | junior | 0.94 | 0.95 | 0.86 | 0.98 | 0.845 | 0.9325 |
| 38 | rhd | m | junior | 0.94 | 0.83 | 0.97 | 0.98 | 0.660 | 0.9300 |
| 39 | roj | m | junior | 0.86 | 0.89 | 0.82 | 0.93 | 0.670 | 0.8750 |
| 40 | sos | m | senior | 0.94 | 0.71 | 0.95 | 0.99 | 0.705 | 0.8975 |
| 41 | spg | m | senior | 0.70 | 0.34 | 0.90 | 0.98 | 0.600 | 0.7300 |
| 42 | stj | m | junior | 0.78 | 0.94 | 0.89 | 0.98 | 0.805 | 0.8975 |
| 43 | stc | m | senior | 0.86 | 0.96 | 0.99 | 0.87 | 0.690 | 0.9200 |
| 44 | tad | m | sophmore | 0.88 | 0.81 | 0.94 | 0.97 | 0.620 | 0.9000 |
| 45 | tom | m | junior | 0.40 | 0.41 | 0.76 | 0.92 | 0.580 | 0.6225 |
| 46 | trb | m | senior | 0.86 | 0.88 | 1.00 | 0.95 | 0.880 | 0.9225 |
| 47 | wac | m | junior | 0.86 | 0.63 | 0.84 | 0.94 | 0.575 | 0.8175 |
| 48 | wer | f | senior | 0.98 | 0.99 | 0.89 | 0.99 | 0.835 | 0.9625 |
| 49 | yec | m | junior | 0.90 | 0.95 | 0.97 | 0.94 | 0.700 | 0.9400 |

1b.



1c. The scatter plot comparing final exam scores to quiz scores show a moderate positive correlation with a few outliers. The scatter plot comparing the lab grade and final exam score shows almost no relationship between two. From the histogram and smoothing curve for the final exam scores, one can see that the distribution is fairly normal (although slightly left-tailed), with the exception of a few low scores, and that the smoothing curve fits pretty well.

1d.



1e. The female/junior graph shows a positive correlation with most points falling into the confidence limit range. The male/junior graph has a poor positive correlation and there are many scores that fall outside of the 95% confidence limit. The female/senior plot has a decent positive relationship of final exam score and average, but there are several points that do not lie near the loess smoothing line. The male/senior plot shows that there are several outliers in this comparison, but the smoothing line does look like it provides a good fit and the relation looks good.

2a.

The SAS System 17:52 Wednesday, November 3, 2010 2

The TTEST Procedure

Variable: Pulse

| N | Mean | Std Dev | Std Err | Minimum | Maximum |
|---------|-------------|---------|----------------|---------|---------|
| 20 | 75.1000 | 7.9796 | 1.7843 | 65.0000 | 100.0 |
| Mean | 95% CL Mean | Std Dev | 95% CL Std Dev | | |
| 75.1000 | 72.0147 | Infty | 7.9796 | 6.0684 | 11.6547 |
| DF | t Value | Pr > t | | | |
| 19 | 2.86 | 0.0050 | | | |

We can reject the null hypothesis that the average heart rate is less than 70. The p-value is 0.0050, so we can conclude that the mean heart rate is greater than 70.

2b.

| | | | | | | | | |
|-----------------------|---------------|-----------|----------------|---------|-----------------------------------|---------|----|--|
| | | | The SAS System | | 17:52 Wednesday, November 3, 2010 | | 10 | |
| The TTEST Procedure | | | | | | | | |
| Variable: score | | | | | | | | |
| Gluc | N | Mean | Std Dev | Std Err | Minimum | Maximum | | |
| FastGluc | 20 | 299.1 | 125.6 | 28.0883 | 152.0 | 568.0 | | |
| PostGluc | 20 | 355.1 | 125.5 | 28.0661 | 206.0 | 625.0 | | |
| Diff (1-2) | | -56.0000 | 125.6 | 39.7071 | | | | |
| Gluc | Method | Mean | 95% CL Mean | Std Dev | 95% CL Std Dev | | | |
| FastGluc | | 299.1 | 240.3 357.9 | 125.6 | 95.5287 183.5 | | | |
| PostGluc | | 355.1 | 296.4 413.8 | 125.5 | 95.4532 183.3 | | | |
| Diff (1-2) | Pooled | -56.0000 | -136.4 24.3829 | 125.6 | 102.6 161.8 | | | |
| Diff (1-2) | Satterthwaite | -56.0000 | -136.4 24.3829 | | | | | |
| | Method | Variances | DF | t Value | Pr > t | | | |
| | Pooled | Equal | 38 | -1.41 | 0.1666 | | | |
| | Satterthwaite | Unequal | 38 | -1.41 | 0.1666 | | | |
| Equality of Variances | | | | | | | | |
| | Method | Num DF | Den DF | F Value | Pr > F | | | |
| | Folded F | 19 | 19 | 1.00 | 0.9973 | | | |

We cannot reject the null hypothesis that the mean of PostGluc is the same as FasGluc. The p-value is 0.1666, so we cannot reject the null.

2c.

| | | | | | |
|---------------------------------|-------------------|---------|--------------------------------------|----------|----------|
| The SAS System | | | 17:52 Wednesday, November 3, 2010 11 | | |
| The TTEST Procedure | | | | | |
| Difference: FastGluc – PostGluc | | | | | |
| N | Mean | Std Dev | Std Err | Minimum | Maximum |
| 20 | -56.0000 | 11.2531 | 2.5163 | -78.0000 | -29.0000 |
| Mean | 95% CL Mean | Std Dev | 95% CL Std Dev | | |
| -56.0000 | -61.2666 -50.7334 | 11.2531 | 8.5579 16.4359 | | |
| DF | t Value | Pr > t | | | |
| 19 | -22.26 | <.0001 | | | |

We can reject the null hypothesis that the mean of PostGluc is not the same as FastGluc. The p-value is 0.0001, so we can reject the null and conclude that the means are different.

2d. When we use the two-sample test, we cannot reject the null hypothesis, but when using the paired t-test we can reject the null. The paired t-test is the correct test to use since the two values were collected from the same subject. The paired t-test matches the data and eliminates the variance between subjects, which skews the test results.

3a.

The SAS System 17:52 Wednesday, November 3, 2010 12

The ANOVA Procedure

Class Level Information

| Class | Levels | Values |
|---------|--------|----------------|
| machine | 3 | A386 A455 C334 |

| | |
|-----------------------------|-----|
| Number of Observations Read | 120 |
| Number of Observations Used | 120 |

The ANOVA Procedure

Dependent Variable: diameter

| Source | DF | Sum of Squares | Mean Square | F Value | Pr > F |
|-----------------|-----|-------------------|-------------|---------|--------|
| Model | 2 | 2.72392236 | 1.36196118 | 10.74 | <.0001 |
| Error | 117 | 14.83875320 | 0.12682695 | | |
| Corrected Total | 119 | 17.56267556 | | | |

| | | | |
|----------|-----------|----------|---------------|
| R-Square | Coeff Var | Root MSE | diameter Mean |
| 0.155097 | 8.172944 | 0.356128 | 4.357398 |

| Source | DF | Anova SS | Mean Square | F Value | Pr > F |
|---------|----|------------|-------------|---------|--------|
| machine | 2 | 2.72392236 | 1.36196118 | 10.74 | <.0001 |

Since the p-value is below 0.5 (0.0001), we can conclude that there are significant differences between the machines.

3b.

The SAS System 17:52 Wednesday, November 3, 2010 17

The ANOVA Procedure

Class Level Information

| Class | Levels | Values |
|---------|--------|----------------|
| machine | 3 | A386 A455 C334 |

| | |
|-----------------------------|-----|
| Number of Observations Read | 120 |
| Number of Observations Used | 120 |

The ANOVA Procedure

Dependent Variable: diameter

| Source | DF | Sum of Squares | Mean Square | F Value | Pr > F |
|-----------------|-----|-------------------|-------------|---------|--------|
| Model | 2 | 2.72392236 | 1.36196118 | 10.74 | <.0001 |
| Error | 117 | 14.83875320 | 0.12682695 | | |
| Corrected Total | 119 | 17.56267556 | | | |

| | | | |
|----------|-----------|----------|---------------|
| R-Square | Coeff Var | Root MSE | diameter Mean |
| 0.155097 | 8.172944 | 0.356128 | 4.357398 |

| Source | DF | Anova SS | Mean Square | F Value | Pr > F |
|---------|----|------------|-------------|---------|--------|
| machine | 2 | 2.72392236 | 1.36196118 | 10.74 | <.0001 |

The ANOVA Procedure

Tukey's Studentized Range (HSD) Test for diameter

NOTE: This test controls the Type I experimentwise error rate, but it generally has a higher Type II error rate than REGWQ.

Alpha 0.05
 Error Degrees of Freedom 117
 Error Mean Square 0.126827
 Critical Value of Studentized Range 3.35722
 Minimum Significant Difference 0.1908
 Harmonic Mean of Cell Sizes 39.27273

NOTE: Cell sizes are not equal.

Means with the same letter are not significantly different.

| Tukey Grouping | Mean | N | machine |
|----------------|---------|----|---------|
| A | 4.49084 | 36 | A455 |
| A | | | |
| A | 4.42727 | 48 | A386 |
| B | 4.13080 | 36 | C334 |

Using the Tukey comparison, we can see that the means of machine A445 and machine A386 are not significantly different from each other, but the mean of machine C334 is different from the other means.

3c.

The ANOVA Procedure

Class Level Information

| Class | Levels | Values |
|----------|--------|-----------------|
| operator | 4 | CMB DRJ MKS RMM |

Number of Observations Read 120
 Number of Observations Used 120

The ANOVA Procedure

Dependent Variable: diameter

| Source | DF | Sum of Squares | Mean Square | F Value | Pr > F |
|-----------------|-----|----------------|-------------|---------|--------|
| Model | 3 | 0.42242761 | 0.14080920 | 0.95 | 0.4176 |
| Error | 116 | 17.14024795 | 0.14776076 | | |
| Corrected Total | 119 | 17.56267556 | | | |

| | | | |
|----------|-----------|----------|---------------|
| R-Square | Coeff Var | Root MSE | diameter Mean |
| 0.024053 | 8.821700 | 0.384397 | 4.357398 |

| | | | | | |
|----------|----|------------|-------------|---------|--------|
| Source | DF | Anova SS | Mean Square | F Value | Pr > F |
| operator | 3 | 0.42242761 | 0.14080920 | 0.95 | 0.4176 |

We cannot conclude that the means of the four operators are significantly different, as the p-value is greater than 0.05.

3d.

The SAS System 17:52 Wednesday, November 3, 2010 20

The ANOVA Procedure

Class Level Information

| | | |
|----------|--------|-----------------|
| Class | Levels | Values |
| operator | 4 | CMB DRJ MKS RMM |

| | |
|-----------------------------|-----|
| Number of Observations Read | 120 |
| Number of Observations Used | 120 |

The SAS System 17:52 Wednesday, November 3, 2010 21

The ANOVA Procedure

Dependent Variable: diameter

| | | | | | |
|-----------------|-----|----------------|-------------|---------|--------|
| Source | DF | Sum of Squares | Mean Square | F Value | Pr > F |
| Model | 3 | 0.42242761 | 0.14080920 | 0.95 | 0.4176 |
| Error | 116 | 17.14024795 | 0.14776076 | | |
| Corrected Total | 119 | 17.56267556 | | | |

| | | | |
|----------|-----------|----------|---------------|
| R-Square | Coeff Var | Root MSE | diameter Mean |
| 0.024053 | 8.821700 | 0.384397 | 4.357398 |

| | | | | | |
|----------|----|------------|-------------|---------|--------|
| Source | DF | Anova SS | Mean Square | F Value | Pr > F |
| operator | 3 | 0.42242761 | 0.14080920 | 0.95 | 0.4176 |

The SAS System 17:52 Wednesday, November 3, 2010 24

The ANOVA Procedure

Tukey's Studentized Range (HSD) Test for diameter

NOTE: This test controls the Type I experimentwise error rate.

| | |
|-------------------------------------|----------|
| Alpha | 0.05 |
| Error Degrees of Freedom | 116 |
| Error Mean Square | 0.147761 |
| Critical Value of Studentized Range | 3.68638 |

Comparisons significant at the 0.05 level are indicated by ***.

| operator Comparison | Difference | | |
|------------------------|------------------|---------------------------------------|---------|
| | Between Means | Simultaneous 95% Confidence Limits | |
| RMM - CMB | 0.05458 | -0.20947 | 0.31863 |
| RMM - MKS | 0.12113 | -0.12657 | 0.36883 |
| RMM - DRJ | 0.14495 | -0.10275 | 0.39265 |
| CMB - RMM | -0.05458 | -0.31863 | 0.20947 |
| CMB - MKS | 0.06656 | -0.20785 | 0.34096 |
| CMB - DRJ | 0.09037 | -0.18404 | 0.36478 |
| MKS - RMM | -0.12113 | -0.36883 | 0.12657 |
| MKS - CMB | -0.06656 | -0.34096 | 0.20785 |
| MKS - DRJ | 0.02381 | -0.23490 | 0.28253 |
| DRJ - RMM | -0.14495 | -0.39265 | 0.10275 |
| DRJ - CMB | -0.09037 | -0.36478 | 0.18404 |
| DRJ - MKS | -0.02381 | -0.28253 | 0.23490 |

From the Tukey comparison, we can see that none of the comparisons are significant at 0.05 since none are marked with ***.