Statistics 140 Winter 17

Hand-In Assignment #7

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An auction house will soon be putting up three vintage violins, A, B, and C up for bidding. Brandon, director of a musical arts foundation, wishes to determine which of these instruments to add to the foundation’s collection. He arranges to have each of the violins played by each of 7 concert violinists. (The players are blindfolded, so that they cannot tell which violin is which and each plays the violins in a random order.) After each violin is played, the player rates the instruments on a 10-point scale of overall excellence. The results are shown in the table below:

|  |  |  |  |
| --- | --- | --- | --- |
|  | Violin | | |
| Player | A | B | C |
| 1 | 9 | 7 | 6 |
| 2 | 9.5 | 6.5 | 8 |
| 3 | 8 | 7 | 5 |
| 4 | 9.5 | 6 | 8.5 |
| 5 | 9.5 | 5 | 6 |
| 6 | 7.5 | 8 | 6.5 |
| 7 | 8 | 6 | 6.2 |

1. Perform the appropriate test of hypothesis (using the Quade Test) to determine whether there is a significant difference in the violins. Use α = 0.05.

**H0: Each ranking within a block is equally likely. There is no difference in violins.**

**Ha: At least one of the violins is different.**

**Blocks: Players = 7**

**Treatments: Violins = 3**

R Code:

> v<-Matrix(c(9,9.5,8,9.5,9.5,7.5,8,7,6.5,7,6,5,8,6,6,8,5,8.5,6,6.5,6.2),7,3,byrow = +FALSE, dimnames = list(players = as.character(1:7),violin =c("A","B","C")))

> v

violin

players A B C

1 9.0 7.0 6.0

2 9.5 6.5 8.0

3 8.0 7.0 5.0

4 9.5 6.0 8.5

5 9.5 5.0 6.0

6 7.5 8.0 6.5

7 8.0 6.0 6.2

> library(stats)

> library(PMCMR)

> quade.test(v)

Quade test

data: v

Quade F = 8.5263, num df = 2, denom df = 12, p-value = 0.004966

**TS: F = 8.5262 with p-value = 0.004966**

**Since the p-value = 0.004966 is less than α = 0.05, we reject H0**

**There is sufficient evidence to indicate that at least one of the violins is significantly different.**

1. Refer to Question 1. If appropriate, employ multiple comparisons (associated with the Quade Test) to determine which violins are different.

**Since we rejected H0 we can perform multiple comparisons.**

R Code:

> posthoc.quade.test(v,dist = "TDist")

Pairwise comparisons using posthoc-Quade test with TDist approximation

data: v

A B

B 0.0063 -

C 0.0177 0.4503

P value adjustment method: holm

|  |  |  |  |
| --- | --- | --- | --- |
|  | **p-value** | **p-value < α?** | **Significantly Different?** |
| **A vs. B** | **0.0063** | **Yes** | **Yes** |
| **A vs. C** | **0.0177** | **Yes** | **Yes** |
| **B vs. C** | **0.4503** | **No** | **No** |

**We can conclude that A vs. B and A vs. C are significantly different from each other.**

1. Perform the appropriate test of hypothesis (using the Friedman Test) to determine whether there is a significant difference in the violins. Use α = 0.05.

**H0: Each ranking within a block is equally likely. There is no difference in violins.**

**Ha: At least one of the violins is different.**

**Blocks: Players = 7**

**Treatments: Violins = 3**

R Code:

> v<-matrix(c(9,9.5,8,9.5,9.5,7.5,8,7,6.5,7,6,5,8,6,6,8,5,8.5,6,6.5,6.2),7,3,byrow = +FALSE, dimnames = list(players = as.character(1:7),violin =c("A","B","C")))

> v

violin

players A B C

1 9.0 7.0 6.0

2 9.5 6.5 8.0

3 8.0 7.0 5.0

4 9.5 6.0 8.5

5 9.5 5.0 6.0

6 7.5 8.0 6.5

7 8.0 6.0 6.2

> library(stats)

> library(PMCMR)

> friedman.test(v)

Friedman rank sum test

data: v

Friedman chi-squared = 7.7143, df = 2, p-value = 0.02113

**TS: X2 = 7.7143 with p-value = 0.02113**

**Since the p-value = 0.02113 is less than α = 0.05, we reject H0**

**There is sufficient evidence to indicate that at least one of the violins is significantly different.**

1. Refer to Question 3. If appropriate, employ multiple comparisons (associated with the Quade Test) to determine which violins are different.

**Since we rejected H0 we can perform multiple comparisons.**

R Code:

> posthoc.friedman.conover.test(v)

Pairwise comparisons using Conover's test for a two-way

balanced complete block design

data: v

A B

B 0.0022 -

C 0.0022 1.0000

P value adjustment method: holm

|  |  |  |  |
| --- | --- | --- | --- |
|  | **p-value** | **p-value < α?** | **Significantly Different?** |
| **A vs. B** | **0.0022** | **Yes** | **Yes** |
| **A vs. C** | **0.0022** | **Yes** | **Yes** |
| **B vs. C** | **1.0000** | **No** | **No** |

**We can conclude that A vs. B and A vs. C are significantly different from each other.**