Exercise section 16

Mehrab Atighi

5/11/2021

section 16:

1)

```
library(heplots)

data(RootStock)
data<-as.data.frame(RootStock)
group<-as.factor(data$rootstock)
response<-cbind(RootStock$girth4,RootStock$ext4,RootStock$girth15,RootStock$w
eight15)
summary(manova(response~group))
```

```
##            Df Pillai approx F num Df den Df    Pr(>F)
## group       5 1.3055   4.0697     20    168 1.983e-07 ***
## Residuals 42
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
means<-data.frame(
mu1<-colMeans(data[1:8,2:5]),
mu2<-colMeans(data[9:16,2:5]),
mu3<-colMeans(data[17:24,2:5]),
mu4<-colMeans(data[25:32,2:5]),
mu5<-colMeans(data[33:40,2:5]),
mu6<-colMeans(data[41:48,2:5])
)
means
```

	mu1....colMeans.data.1.8..2.5..	mu2....colMeans.data.9.16..2.5..	mu3....colMeans.data.17.24..2.5..	mu4....colMeans.data.25.32..2.5..	mu5....colMeans.data.33.40..2.5..	mu6....colMeans.data.41.48..2.5..
girth4	1.137500	1.157500	1.107500	1.09750	1.08000	1.036250
ext4	2.977125	3.109125	2.815250	2.87975	2.55725	2.214625
girth15	3.738750	4.515000	4.455000	3.90625	4.31250	3.596250
weight15	0.871125	1.280500	1.391375	1.03900	1.18100	0.735000

حال در بالا میتوانیم بردارهای میانگین را مشاهده بکنیم.

```
colSums(means)
```

```
##   mu1....colMeans.data.1.8..2.5..  mu2....colMeans.data.9.16..2.5..
##                          8.724500                         10.062125
## mu3....colMeans.data.17.24..2.5.. mu4....colMeans.data.25.32..2.5..
##                          9.769125                          8.922500
## mu5....colMeans.data.33.40..2.5.. mu6....colMeans.data.41.48..2.5..
##                          9.130750                          7.582125
```

با توجه به آخرین خروجی نیز می‌توان مشاهده کرد که جمع میانگین های جامعه دوم از همه با اهمیت تر هستش.

2)

a)

H0 : mu1 = mu2 = mu3 H1 : At least one of the means is not equal

b)

```
M1y1<-c(5.4,5.2,6.1,4.8,5.0,5.7,6.0,4.0,5.7,5.6,5.8,5.3)
M1y2<-c(6,6.2,5.9,5,5.7,6.1,6,5,5.4,5.2,6.1,5.9)
M1y3<-c(6.3,6,6,4.9,5,6,5.8,4,4.9,5.4,5.2,5.8)
M1y4<-c(6.7,5.8,7,5,6.5,6.6,6,5,5,5.8,6.4,6)
M2y1<-c(5,4.8,3.9,4,5.6,6,5.2,5.3,5.9,6.1,6.2,5.1)
M2y2<-c(5.3,4.9,4,5.1,5.4,5.5,4.8,5.1,6.1,6,5.7,4.9)
M2y3<-c(5.3,4.2,4.4,4.8,5.1,5.7,5.4,5.8,5.7,6.1,5.9,5.3)
M2y4<-c(6.5,5.6,5.0,5.8,6.2,6.0,6,6.4,6,6.2,6,4.8)
M3y1<-c(4.8,5.4,4.9,5.7,4.2,6,5.1,4.8,5.3,4.6,4.5,4.4)
M3y2<-c(5,5,5.1,5.2,4.6,5.3,5.2,4.6,5.4,4.4,4.0,4.2)
M3y3<-c(6.5,6,5.9,6.4,5.3,5.8,6.2,5.7,6.8,5.7,5,5.6)
M3y4<-c(7,6.4,6.5,6.4,6.3,6.4,6.5,5.7,6.6,5.6,5.9,5.5)

Method<-factor(rep(c(1:3), each = 48))
variable<-factor(rep(c(1:12),12))
response<-c(M1y1,M1y2,M1y3,M1y4,M2y1,M2y2,M2y3,M2y4,M3y1,M3y2,M3y3,M3y4)
result<-aov(response~Method+variable)
summary(result)
```

```
##              Df Sum Sq Mean Sq F value Pr(>F)
## Method        2   1.11  0.5526   1.222 0.2981
## variable     11   8.07  0.7336   1.622 0.0997 .
## Residuals   130  58.80  0.4523
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

c)

for y1: method1:

```
response<-c(M1y1,M2y1,M3y1)
group<-factor(rep(1:3,each = 12))
result<-aov(response~group)
summary(result)

##             Df Sum Sq Mean Sq F value Pr(>F)
## group        2  1.051  0.5253   1.293  0.288
## Residuals   33 13.408  0.4063
```

method2:

```
data<-cbind(response,group)
r<-oneway.test(response~group , data = data ,var.equal = TRUE)
r

##
##  One-way analysis of means
##
## data:  response and group
## F = 1.2928, num df = 2, denom df = 33, p-value = 0.288
```

for y2: method1:

```
response<-c(M1y2,M2y2,M3y2)
group<-factor(rep(1:3,each = 12))
result<-aov(response~group)
summary(result)

##             Df Sum Sq Mean Sq F value   Pr(>F)
## group        2  4.605  2.3025   9.378 0.000596 ***
## Residuals   33  8.103  0.2455
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

method2:

```
data<-cbind(response,group)
r<-oneway.test(response~group , data = data ,var.equal = TRUE)
r

##
##  One-way analysis of means
##
## data:  response and group
## F = 9.3777, num df = 2, denom df = 33, p-value = 0.000596
```

for y3: method1:

```
response<-c(M1y3,M2y3,M3y3)
group<-factor(rep(1:3,each = 12))
result<-aov(response~group)
summary(result)

##             Df Sum Sq Mean Sq F value Pr(>F)
## group        2  2.382  1.1911   3.386  0.046 *
## Residuals   33 11.607  0.3517
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

method2:

```
data<-cbind(response,group)
r<-oneway.test(response~group , data = data ,var.equal = TRUE)
r
##  One-way analysis of means
##
## data:  response and group
## F = 3.3863, num df = 2, denom df = 33, p-value = 0.04596
```

for y4: method1:

```
response<-c(M1y4,M2y4,M3y4)
group<-factor(rep(1:3,each = 12))
result<-aov(response~group)
summary(result)

##             Df Sum Sq Mean Sq F value Pr(>F)
## group        2  0.811  0.4053   1.266  0.295
## Residuals   33 10.566  0.3202
```

method2:

```
data<-cbind(response,group)
r<-oneway.test(response~group , data = data ,var.equal = TRUE)
r
##  One-way analysis of means
##
## data:  response and group
## F = 1.2658, num df = 2, denom df = 33, p-value = 0.2954
```

d)

for each test we have alpha = 0.05 and when we use 4 test total error will be 4*0.05 = 0.2 so its better that we use 1 manova our multiple anova test just with 0.05 error.

خطای ما به 0.2 افزایش خواهد یافت.زیرا 4 تا 0.05 ازمون شده است.