Question 2

October 28, 2020

1 Question 2

For this question I simply used the equations given in the question/lecture notes. As the tbale is small I inputted the data manually. The degrees of freedom between the samples was calculated from (r-1)=2 as the number of samples was 3. The degrees of freedom within the samples is N-3=267. The P value was calculated from the online applet linked below.

[18]:
```python
import numpy as np
import matplotlib.pyplot as plt

print('Pre-test')
#init
r = 3
n_1 = 90
n_2 =90
n_3 =90
N = n_1+n_2+n_3

m = ((n_1*3.02)+(n_2*3.12)+(n_3*3.01))/N
print(m)



SS_b = n_1*(3.02-m)**2 + n_2*(3.12-m)**2+n_3*(3.01-m)**2
print('SS_b = %f' %SS_b)
SS_w = (n_1-1)* 1.54 + (n_2-1)*1.39+(n_3-1)*1.42
print('SS_w =%f'%SS_w)

F = (SS_b/(r-1)) / (SS_w/(N-r))
print('F=%f'%F)

print('Dof-SS_b = 2, Dof-SS_w = 267, P value = 0.79496')
print('https://homepage.divms.uiowa.edu/~mbognar/applets/f.html')
```

```
Pre-test
3.05
SS_b = 0.666000
SS_w =387.150000
```

```
F=0.229655
Dof-SS_b = 2, Dof-SS_w = 267, P value = 0.79496
https://homepage.divms.uiowa.edu/~mbognar/applets/f.html
```

As shown, the problem solving ability of the students before being exposed to anything was similar.

Part 2. The problem solving ability of the students after the test was not similar.

[19]:
```
print('Post-test')
m = ((n_1*4.85)+(n_2*3.72)+(n_3*3.22))/N

SS_b = n_1*(4.85-m)**2 + n_2*(3.72-m)**2+n_3*(3.22-m)**2
print('SS_b = %f' %SS_b)
SS_w = (n_1-1)* 0.59 + (n_2-1)*0.97+(n_3-1)*1.21
print('SS_w =%f'%SS_w)

F = (SS_b/(r-1)) / (SS_w/(N-r))
print('F=%f'%F)

print('Dof-SS_b = 2, Dof-SS_w = 267, P value = 0')
print('https://homepage.divms.uiowa.edu/~mbognar/applets/f.html')
```

```
Post-test
SS_b = 125.514000
SS_w =246.530000
F=67.967870
Dof-SS_b = 2, Dof-SS_w = 267, P value = 0
https://homepage.divms.uiowa.edu/~mbognar/applets/f.html
```

[17]:
```
from scipy.stats import f

mean_var_1 = np.mean([0.59,0.97])
mean_var_2= np.mean([0.59,1.21])
mean_var_3=np.mean([1.21,0.97])
F_1 = f.isf(0.05,2,267)

Scheffe_TS = np.sqrt((r-1)*F_1*mean_var_1*(1/90+1/90)) #between TDPS and SDPS
Scheffe_TL = np.sqrt((r-1)*F_1*mean_var_2*(1/90+1/90)) #between TDPS and TL
Scheffe_LS = np.sqrt((r-1)*F_1*mean_var_3*(1/90+1/90)) #between TL and SDPS

Diff_TS = np.abs(4.85-3.72)
Diff_TL = np.abs(4.85-3.22)
Diff_LS = np.abs(3.22-3.72)

print('TDPS-SDPS: Diff= %f Scheffe=%f' %(Diff_TS, Scheffe_TS))
print('TDPS-TL: Diff= %f Scheffe=%f' %(Diff_TL, Scheffe_TL))
print('TL-SDPS: Diff= %f Scheffe=%f' %(Diff_LS, Scheffe_LS))
```

```
TDPS-SDPS: Diff= 1.130000 Scheffe=0.324077
```

```
TDPS-TL: Diff= 1.630000 Scheffe=0.348115
TL-SDPS: Diff= 0.500000 Scheffe=0.383102
```

Part 3. The post hoc Scheffe test shows us that between TDPS and SDPS and between TDPS and TL are statistically significant as they are larger than their Scheffe test counterparts, whereas between TL and SDPS they are not. So we can say that comparing teaching methods between TDPS and SDPS and TL are sigificant (however this doesn't necesserily allow us to conclude than TDPS is better than SDPS or TL).Between TL and SDPS the teaching methods are insigificant.

Using the Scheffe test we can determine which comparisons are worth looking at.

[ ]:

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[ ]:

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