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In [25]: #Assignment 4  
#Ho Wing Wing
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```
In [1]: import numpy as np  
import scipy as sci  
from scipy import stats
```

```
In [5]: #15.4  
pp = [0.3, 0.4, -1.7, -0.5, -2.1, 1.3, 0.8, 1.5, -1.2, -0.2, 1.7, 1.2,  
0.6, 0.4, -1.3, -0.2, 0.7]  
ps = [-3.7, -1, 0.2, -2.3, 1.5, -1.4, 1.2, -2.5, -3.3, 0.2, 0.6, -0.7,  
-0.1, -3.1, 0.3, -0.5, -0.8, -0.7, -0.9, -2.0, -0.6]  
gp = [-3.8, -3.2, -4.9, -5.2, -2.2, -3.5, -4.4, -0.8, -1.8, -4, -1.9, -3,  
-1.8, -2.9, -2.9, -2.9, -3.7]  
gs = [-5, -5, -3, -2.6, -6.2, -7, -4.5, -4.2, -5.2, -6.2, -4, -3.9, -3.3,  
-5.7, -4.5, -4.3, -4, -4.2, -4.7 ]  
  
F, P = stats.f_oneway(pp, ps, gp, gs)  
print('F = ', F)  
print('P = ', P)  
print('Because P < .01, we reject null hypothesis')  
  
F = 53.7929620351  
P = 3.80675064247e-18  
Because P < .01, we reject null hypothesis
```

```
In [6]: #15.6  
ap = [2, 3, 4, 1, 3, 3, 3, 3, 2, 2, 1, 3, 2, 2, 2, 3, 2, 2, 3, 4]  
sr = [3, 2, 1, 2, 3, 4, 3, 2, 4, 4, 4, 4, 2, 3, 2, 2, 2, 3, 1, 3]  
hr = [3, 4, 3, 1, 2, 1, 4, 2, 2, 2, 3, 3, 4, 3, 3, 2, 3, 4, 2, 4]  
hm = [4, 3, 4, 3, 3, 3, 3, 3, 2, 4, 4, 5, 4, 5, 3, 4, 5, 4, 2, 3]  
  
F, P = stats.f_oneway(ap, sr, hr, hm)  
print('F = ', F)  
print('P = ', P)  
print('Because P < .01, we reject null hypothesis')  
  
F = 5.09441836202  
P = 0.00288412265128  
Because P < .01, we reject null hypothesis
```

```
In [9]: #15.8
F = 6.62
df = 2
Denominator = 65
SSTr = 24*((6.6-5.72)**2) + 24*((5.37-5.72)**2) + 20*((5.2-5.72)**2)
MSTr = SSTr/df
MSE = MSTr/F
print('a,')
print('F = ', F)
print('df = ', df)
print('Denominator = ', Denominator)
print('b,')
print('P-value = ', 0.002)
print('Because P < 0.05, we reject null')
print('c,')
print('N = 68')
print('mean = 5.72')
print('SSTr = ', SSTr)
print('MSTr = ', MSTr)
print('MSE = ', MSE)
```

```
a,
F = 6.62
df = 2
Denominator = 65
b,
P-value = 0.002
Because P < 0.05, we reject null
c,
N = 68
mean = 5.72
SSTr = 26.933599999999998
MSTr = 13.466799999999999
MSE = 2.0342598187311163
```

```
In [12]: #15.14a
Ex = 83140.06
Total = 1412.02
n = 24
SSTo = Ex - (Total**2)/n
SSTr = (344.96**2)/6 + (347.71**2)/6 + (357.32**2)/6 + (362.03**2)/6 - (1412.02**2)/24
SSE = SSTo - SSTr
dftotal = 23
dftreat = 3
dferror = 20
print('SSTo = ', SSTo)
print('SSTr = ', SSTr)
print('SSE, ', SSE)
print('df of total = ', dftotal)
print('df of treatments = ', dftreat)
print('df of error = ', dferror)

SSTo = 65.03998333333584
SSTr = 32.13814999999886
SSE, 32.90183333333698
df of total = 23
df of treatments = 3
df of error = 20
```

```
In [18]: #15.20
ai = [1.56, 1.06, 0.87, 1.39, 0.71, 0.87]
iwlos = [1.51, 1.78, 1.45, 1.13, 1.87, 1.89, 1.07, 1.72]
iwlom = [1.21, 1.34, 1.95, 2.27, 0.88, 1.67, 2.57]
F, P = stats.f_oneway(ai, iwlos, iwlom)
print('F = ', F)
print('P = ', P)
print('Because P > 0.05, we cannot reject null hypothesis')

F = 3.50890885238
P = 0.0516663442145
Because P > 0.05, we cannot reject null hypothesis
```

In [24]: #15.22

```
mean = 5.98
n = 8703
SSTr = 1256*((7.52-5.98)**2) + 1107*((2.69-5.98)**2)+759*((5.51-
5.98)**2)+1334*((5.39-5.98)**2)+\
1039*((9.16-5.98)**2)+1057*((4.03-5.98)**2)+2151*((6.75-5.98)**2)
dftreatment = 6
SSE = (1256-1)*41.09+(1107-1)*7.08+(759-1)*41.47+(1334-1)*16.56+(1039-
1)*54.46+(1057-1)*9.18+(2151-1)*30.14
dferror = 8696
F = (SSTr/dftreatment)/(SSE/dferror)
print('SSTr = ',SSTr)
print('SSE = ', SSE)
print('F = ', F)
print('Because P < 0.001, we reject null hypothesis')
```

```
SSTr = 31394.390799999997
SSE = 243931.72999999998
F = 186.53144085082056
Because P < 0.001, we reject null hypothesis
```

In []: