LP#43 반복수가 같은 일원배치

In [81]:

```
import scipy.stats as stats
import pandas as pd
import urllib
from statsmodels.formula.api import ols
from statsmodels.stats.anova import anova_lm
import matplotlib.pyplot as plt
import numpy as np
%matplotlib inline
import warnings
warnings.filterwarnings('ignore')
```

In [82]:

```
data = pd.read_csv('One-way ANOVA.csv')
```

In [83]:

```
df = pd.DataFrame(data)
```

In [84]:

```
df
```

Out[84]:

	인장강도	온도
0	8.44000	1
1	8.36000	1
2	8.28000	1
3	8.59000	2
4	8.91000	2
5	8.60000	2
6	9.34000	3
7	9.41000	3
8	9.69000	3
9	8.92000	4
10	8.92000	4
11	8.74000	4

In [85]:

```
model = ols('인장강도 ~ C(온도)', df).fit()

print(anova_lm(model))
```

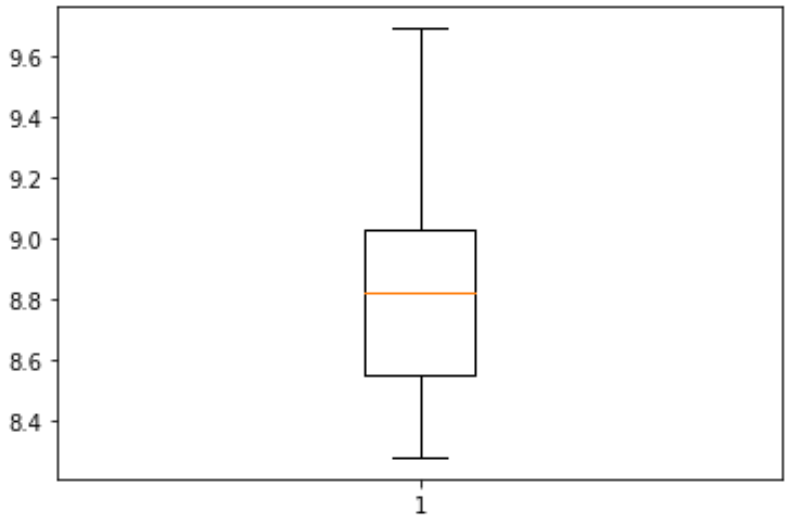
```
             df  sum_sq  mean_sq       F  PR(>F)
C(온도)    3.00000 1.97880  0.65960 31.18676 0.00009
Residual 8.00000 0.16920  0.02115     NaN    NaN
```

ANOVA TABLE

	df	SS	MS	F 비	P-value
A(반응온도)	3.0	1.9788	0.65960	31.186761	0.000092
Residual(오차)	8.0	0.1692	0.02115		

In [9

```
plot_data = [df['인장강도']]
ax = plt.boxplot(plot_data)
plt.show()
```



LP#47 반복없는 이원배치

In [86]:

```
data = pd.read_csv('Two-way ANOVA.csv')
```

In [87]:

```
df = pd.DataFrame(data)
```

In [88]:

```
df
```

Out[88]:

	수율	반응온도	압력
0	97.60000	1	1
1	97.30000	1	2
2	96.70000	1	3
3	98.60000	2	1
4	98.20000	2	2
5	96.90000	2	3
6	99.00000	3	1
7	98.00000	3	2
8	97.90000	3	3
9	98.00000	4	1
10	97.70000	4	2
11	96.50000	4	3

In [91]:

```
pd.options.display.float_format = '{:.5f}'.format
formula = '수율 ~ C(반응온도)+C(압력)'
lm = ols(formula, df).fit()
print(anova_lm(lm))
```

```
              df  sum_sq  mean_sq       F  PR(>F)
C(반응온도)  3.00000 2.22000  0.74000  7.92857 0.01647
C(압력)    2.00000 3.44000  1.72000 18.42857 0.00274
Residual 6.00000 0.56000  0.09333      NaN    NaN
```

ANOVA TABLE

	df	SS	MS	F 비	P-value
A(반응온도)	3.00000	2.22000	0.74000	7.92857	0.01647
B(압력)	2.00000	3.44000	1.72000	18.42857	0.00274
Residual(오차)	6.00000	0.56000	0.09333		

LP#3-2-2-2-1 난괴법

In [120]:

```
data = pd.read_csv('RBD.csv')
```

In [121]:

```
df = pd.DataFrame(data)
```

In [122]:

```
df
```

Out[122]:

	결정화도변화율	온도	습도
0	13.10000	1	1
1	12.90000	1	2
2	13.40000	1	3
3	12.40000	2	1
4	12.70000	2	2
5	12.50000	2	3
6	12.30000	3	1
7	12.00000	3	2
8	12.20000	3	3

In [123]:

```
pd.options.display.float_format = '{:.5f}'.format
formula = '결정화도변화율 ~ C(온도)+C(습도)'
lm = ols(formula, df).fit()
print(anova_lm(lm))
```

```
             df  sum_sq  mean_sq       F  PR(>F)
C(온도)    2.00000 1.42889  0.71444 16.07500 0.01224
C(습도)    2.00000 0.04222  0.02111  0.47500 0.65299
Residual 4.00000 0.17778  0.04444      NaN     NaN
```

ANOVA TABLE

	df	SS	MS	F 비	P-value
A(온도)	2.00000	1.42889	0.71444	16.07500	0.01224
B(습도)	2.00000	0.04222	0.02111	0.47500	0.65299
Residual(오차)	4.00000	0.17778	0.04444		

Pooling

In [127]:

```
model = ols('결정화도변화율 ~ C(온도)', df).fit()

print(anova_lm(model))
```

```
             df  sum_sq  mean_sq       F  PR(>F)
C(온도)    2.00000 1.42889  0.71444 19.48485 0.00238
Residual 6.00000 0.22000  0.03667      NaN     NaN
```

ANOVA TABLE

	df	SS	MS	F 비	P-value
A(반응온도)	2.00000	1.42889	0.71444	19.48485	0.00238
Residual(오차)	6.00000	0.22000	0.03667		

LP#48 반복있는 이원배치

In [92]:

```
data = pd.read_csv('1two-way ANOVA.csv')
```

In [93]:

```
df = pd.DataFrame(data)
```

In [94]:

```
df
```

Out[94]:

	압축강도	석고종류	첨가량
0	305	1	1
1	302	1	1
2	335	1	2
3	337	1	2
4	366	1	3
5	364	1	3
6	372	1	4
7	374	1	4
8	376	1	5
9	373	1	5
10	348	1	6
11	350	1	6
12	322	2	1
13	325	2	1
14	350	2	2
15	348	2	2
16	326	2	3
17	324	2	3
18	330	2	4
19	330	2	4
20	327	2	5
21	330	2	5

	압축강도	석고종류	첨가량
22	310	2	6
23	308	2	6
24	320	3	1
25	322	3	1
26	342	3	2
27	344	3	2
28	338	3	3
29	336	3	3
30	348	3	4
31	348	3	4
32	350	3	5
33	350	3	5
34	330	3	6
35	328	3	6

In [97]:

```
pd.options.display.float_format = '{:.5f}'.format
formula = '압축강도 ~ C(석고종류) + C(첨가량) + C(석고종류):C(첨가량)'
lm = ols(formula, df).fit()
print(anova_lm(lm))
```

```
                    df     sum_sq    mean_sq        F  PR(>F)
C(석고종류)          2.00000 3088.22222 1544.11111 694.85000
0.00000
C(첨가량)           5.00000 5548.88889 1109.77778 499.40000
0.00000
C(석고종류):C(첨가량) 10.00000 4825.77778  482.57778 217.16000
0.00000
Residual       18.00000   40.00000    2.22222       NaN     NaN
```

ANOVA TABLE

	df	SS	MS	F 비	P-value
A(석고종류)	2.00000	3088.22222	1544.11111	694.85000	0.00000
B(첨가량)	5.00000	5548.88889	1109.77778	499.40000	0.00000
A(석고종류)XB(첨가량)	10.00000	4825.77778	482.57778	217.16000	0.00000
Residual(오차)	18.00000	40.00000	2.22222		

LP#3-4 반복없는 삼원배치법

In [109]:

```
data = pd.read_csv('Three-way ANOVA.csv')
```

In [110]:

```
df = pd.DataFrame(data)
```

In [111]:

```
df
```

Out[111]:

	합성률	반응압력	반응시간	반응온도
0	74	1	1	1
1	86	1	1	2
2	76	1	1	3
3	72	1	2	1
4	91	1	2	2
5	87	1	2	3
6	48	1	3	1
7	65	1	3	2
8	56	1	3	3
9	61	2	1	1
10	78	2	1	2
11	71	2	1	3
12	62	2	2	1
13	81	2	2	2
14	77	2	2	3
15	55	2	3	1
16	72	2	3	2
17	63	2	3	3
18	50	3	1	1
19	70	3	1	2
20	60	3	1	3
21	49	3	2	1

	합성률	반응압력	반응시간	반응온도
22	68	3	2	2
23	64	3	2	3
24	52	3	3	1
25	69	3	3	2
26	60	3	3	3

In [114]:

```
pd.options.display.float_format = '{:.5f}'.format
formula = '합성률 ~ C(반응압력) + C(반응시간) + C(반응온도) + C(반응압력):C(반응시간)+ C(반응압력):C(반응온도) + C(반응시간):C(반응온도)'
lm = ols(formula, df).fit()
print(anova_lm(lm))
```

```
                      df     sum_sq   mean_sq         F  PR(>F)
C(반응압력)          2.00000  743.62963 371.81481 164.57377
0.00000
C(반응시간)          2.00000  753.40741 376.70370 166.73770
0.00000
C(반응온도)          2.00000 1380.96296 690.48148 305.62295
0.00000
C(반응압력):C(반응시간) 4.00000  651.92593 162.98148  72.13934
0.00000
C(반응압력):C(반응온도) 4.00000    9.03704   2.25926   1.00000
0.46091
C(반응시간):C(반응온도) 4.00000   56.59259  14.14815   6.26230
0.01384
Residual          8.00000   18.07407   2.25926       NaN     NaN
```

ANOVA TABLE

	df	SS	MS	F 비	P-value
A(반응압력)	2.00000	743.62963	371.81481	164.57377	0.00000
B(반응시간)	2.00000	753.40741	376.70370	166.73770	0.00000
C(반응온도)	2.00000	1380.96296	690.48148	305.62295	0.00000
A(반응압력) X B(반응시간)	4.00000	651.92593	162.98148	72.13934	0.00000
A(반응압력) X C(반응온도)	4.00000	9.03704	2.25926	1.00000	0.46091
B(반응시간) X C(반응온도)	4.00000	56.59259	14.14815	6.26230	0.01384
Residual(오차)	8.00000	18.07407	2.25926		

Pooling

In [116]:

```
pd.options.display.float_format = '{:.5f}'.format
formula = '합성률 ~ C(반응압력) + C(반응시간) + C(반응온도) + C(반응압력):C(반응시간) + C(반응시간):C(반응온도)'
lm = ols(formula, df).fit()
print(anova_lm(lm))
```

```
                          df     sum_sq   mean_sq         F  PR(>F)
C(반응압력)             2.00000  743.62963 371.81481 164.57377
0.00000
C(반응시간)             2.00000  753.40741 376.70370 166.73770
0.00000
C(반응온도)             2.00000 1380.96296 690.48148 305.62295
0.00000
C(반응압력):C(반응시간)  4.00000  651.92593 162.98148  72.13934
0.00000
C(반응시간):C(반응온도)  4.00000   56.59259  14.14815   6.26230
0.00584
Residual               12.00000   27.11111   2.25926       NaN     NaN
```

ANOVA TABLE

	df	SS	MS	F 비	P-value
A(반응압력)	2.00000	743.62963	371.81481	164.57377	0.00000
B(반응시간)	2.00000	753.40741	376.70370	166.73770	0.00000
C(반응온도)	2.00000	1380.96296	690.48148	305.62295	0.00000
A(반응압력) X B(반응시간)	4.00000	651.92593	162.98148	72.13934	0.00000
B(반응시간) X C(반응온도)	4.00000	56.59259	14.14815	6.26230	0.00584
Residual(오차)	12.00000	27.11111	2.25926		