

플라스틱의 3가지 유형을 시험한 결과

플라스틱 유형 / 습도	30%	50%	70%	90%
a	39.0	33.1	33.8	33.0
b	36.9	27.2	29.7	28.5
c	27.4	29.2	26.7	30.9

In [30]:

연습문제 3 p371, node (7)

접착된 레고(플라스틱) 조각들을 떼어놓는데 필요한 힘을 결정하기 위하여 연구가 이루어졌을 때, 네 가지의 습도를 사용하여

```
from scipy import stats
from math import sqrt
```

```
data = [[39.0, 33.1, 33.8, 33.0],
        [36.9, 27.2, 29.7, 28.5],
        [27.4, 29.2, 26.7, 30.9]]
```

```
n_rows = len(data)
n_cols = len(data[0])
n_total = n_rows * n_cols
```

```
grand_mean = sum([sum(row) for row in data]) / n_total
ss_humidity = sum([(sum(data[i]) / n_cols) - grand_mean]**2 for i in range(n_rows)]) * n_cols
ss_plastic_type = sum([((sum([data[i][j] for i in range(n_rows)]) / n_rows) - grand_mean)**2 for j in range(n_cols))] * n_rows
ss_total = sum([(data[i][j] - grand_mean)**2 for i in range(n_rows) for j in range(n_cols)])
ss_error = ss_total - ss_humidity - ss_plastic_type
df_humidity = n_rows - 1
df_plastic_type = n_cols - 1
df_error = df_humidity * df_plastic_type
df_total = n_total - 1
ms_humidity = ss_humidity / df_humidity
ms_plastic_type = ss_plastic_type / df_plastic_type
ms_error = ss_error / df_error
f_humidity = ms_humidity / ms_error
f_plastic_type = ms_plastic_type / ms_error
p_humidity = stats.f.sf(f_humidity, df_humidity, df_error)
p_plastic_type = stats.f.sf(f_plastic_type, df_plastic_type, df_error)
```

```
print('요인\테제곱합\테자유도\테평균제곱\테F-통계량\테P-value')
print('A\테{:.3f}\테{\테{:.3f}\테{:.3f}\테{:.3f}'.format(ss_humidity, df_humidity, ms_humidity, f_humidity, p_humidity))
print('B\테{:.3f}\테{\테{:.3f}\테{:.3f}\테{:.3f}'.format(ss_plastic_type, df_plastic_type, ms_plastic_type, f_plastic_type, p_plastic_type))
print('오차\테{:.3f}\테{\테{:.3f}\테{:.3f}'.format(ss_error, df_error, ms_error))
print('총합\테{:.3f}\테{\테{:.3f}\테{:.3f}'.format(ss_total, df_total))
```

```
요인 제곱합 자유도 평균제곱 F-통계량 P-value
A 79.272 2 39.636 4.692 0.059
B 41.217 3 13.739 1.626 0.280
오차 50.688 6 8.448
```

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