```
!wget --no-check-certificate https://drive.google.com/uc?id=1BbOJnKXUEPWrhjjLlZS_2-HoGvtZeubb -O wei
```

```
--2024-07-05 15:56:07--  https://drive.google.com/uc?id=1BbOJnKXUEPWrhjjLlZS_2-HoGvtZeubb
Resolving drive.google.com (drive.google.com)... 74.125.20.100, 74.125.20.138, 74.125.20.139, ...
Connecting to drive.google.com (drive.google.com)|74.125.20.100|:443... connected.
HTTP request sent, awaiting response... 303 See Other
Location: https://drive.usercontent.google.com/download?id=1BbOJnKXUEPWrhjjLlZS_2-HoGvtZeubb [following]
--2024-07-05 15:56:07--  https://drive.usercontent.google.com/download?id=1BbOJnKXUEPWrhjjLlZS_2-HoGvtZeubb
Resolving drive.usercontent.google.com (drive.usercontent.google.com)... 173.194.202.132, 2607:f8b0:400e:c00::84
Connecting to drive.usercontent.google.com (drive.usercontent.google.com)|173.194.202.132|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 428120 (418K) [application/octet-stream]
Saving to: 'weight-height.csv'

weight-height.csv   100%[===================>] 418.09K  --.-KB/s    in 0.004s

2024-07-05 15:56:08 (100 MB/s) - 'weight-height.csv' saved [428120/428120]
```

```
import numpy as np
import pandas as pd
```

```
df_hw = pd.read_csv("weight-height.csv")
df_hw.head()
```

	Gender	Height	Weight
0	Male	73.847017	241.893563
1	Male	68.781904	162.310473
2	Male	74.110105	212.740856
3	Male	71.730978	220.042470
4	Male	69.881796	206.349801

```
height_men = df_hw[df_hw["Gender"]=="Male"]["Height"]
height_women = df_hw[df_hw["Gender"]=="Female"]["Height"]
```

```
print("Mean of men height:",height_men.mean() , "Mean of women height:",height_women.mean())
```

```
Mean of men height: 69.02634590621741 Mean of women height: 63.70877360342507
```

```
print("Variance of men height:",height_men.var() , "Variance of women height:",height_women.var())
```

```
Variance of men height: 8.198843252520467 Variance of women height: 7.2699474936701245
```

```
from scipy.stats import levene
```

```
levene(height_women, height_men)
```

```
LeveneResult(statistic=12.284910854677701, pvalue=0.0004586349895436178)
```

2-way anova

```
!wget --no-check-certificate https://drive.google.com/uc?id=1Vy0OPYInhYxuZzSn415DsguHWVH7ROe0 -O tw
```

```
--2024-07-05 16:11:27--  https://drive.google.com/uc?id=1Vy0OPYInhYxuZzSn415DsguHWVH7ROe0
Resolving drive.google.com (drive.google.com)... 74.125.20.101, 74.125.20.100, 74.125.20.138, ...
Connecting to drive.google.com (drive.google.com)|74.125.20.101|:443... connected.
HTTP request sent, awaiting response... 303 See Other
Location: https://drive.usercontent.google.com/download?id=1Vy0OPYInhYxuZzSn415DsguHWVH7ROe0 [following]
--2024-07-05 16:11:27--  https://drive.usercontent.google.com/download?id=1Vy0OPYInhYxuZzSn415DsguHWVH7ROe0
Resolving drive.usercontent.google.com (drive.usercontent.google.com)... 173.194.202.132, 2607:f8b0:400e:c00::84
Connecting to drive.usercontent.google.com (drive.usercontent.google.com)|173.194.202.132|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 1541 (1.5K) [application/octet-stream]
Saving to: 'two_way_anova.csv'

two_way_anova.csv   100%[===================>]   1.50K  --.-KB/s    in 0s
```

```
2024-07-05 16:11:28 (37.5 MB/s) - 'two_way_anova.csv' saved [1541/1541]
```

```
df=pd.read_csv('two_way_anova.csv')
df.head()
```

	Flavour	Location	Sales
0	Orange	West	141
1	Lemon	West	178
2	Orange	West	170
3	Orange	East	76
4	Lemon	East	170

```
df.Flavour.value_counts()
```

```
Flavour
Cola      36
Lemon     33
Orange    31
Name: count, dtype: int64
```

```
df.Location.value_counts()
```

```
Location
East     34
West     25
North    22
South    19
Name: count, dtype: int64
```

```
!pip install pingouin
```

```
Collecting pingouin
  Downloading pingouin-0.5.4-py2.py3-none-any.whl (198 kB)
     ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 198.9/198.9 kB 5.8 MB/s eta 0:00:00
Requirement already satisfied: numpy in /usr/local/lib/python3.10/dist-packages (from pingouin) (1.25.2)
Requirement already satisfied: scipy in /usr/local/lib/python3.10/dist-packages (from pingouin) (1.11.4)
Requirement already satisfied: pandas>=1.5 in /usr/local/lib/python3.10/dist-packages (from pingouin) (2.0.3)
Requirement already satisfied: matplotlib in /usr/local/lib/python3.10/dist-packages (from pingouin) (3.7.1)
Requirement already satisfied: seaborn in /usr/local/lib/python3.10/dist-packages (from pingouin) (0.13.1)
Requirement already satisfied: statsmodels in /usr/local/lib/python3.10/dist-packages (from pingouin) (0.14.2)
Requirement already satisfied: scikit-learn in /usr/local/lib/python3.10/dist-packages (from pingouin) (1.2.2)
Collecting pandas-flavor (from pingouin)
  Downloading pandas_flavor-0.6.0-py3-none-any.whl (7.2 kB)
Requirement already satisfied: tabulate in /usr/local/lib/python3.10/dist-packages (from pingouin) (0.9.0)
Requirement already satisfied: python-dateutil>=2.8.2 in /usr/local/lib/python3.10/dist-packages (from pandas>=1.5->pingouin
Requirement already satisfied: pytz>=2020.1 in /usr/local/lib/python3.10/dist-packages (from pandas>=1.5->pingouin) (2023.4)
Requirement already satisfied: tzdata>=2022.1 in /usr/local/lib/python3.10/dist-packages (from pandas>=1.5->pingouin) (2024.
Requirement already satisfied: contourpy>=1.0.1 in /usr/local/lib/python3.10/dist-packages (from matplotlib->pingouin) (1.2.
Requirement already satisfied: cycler>=0.10 in /usr/local/lib/python3.10/dist-packages (from matplotlib->pingouin) (0.12.1)
Requirement already satisfied: fonttools>=4.22.0 in /usr/local/lib/python3.10/dist-packages (from matplotlib->pingouin) (4.5
Requirement already satisfied: kiwisolver>=1.0.1 in /usr/local/lib/python3.10/dist-packages (from matplotlib->pingouin) (1.4
Requirement already satisfied: packaging>=20.0 in /usr/local/lib/python3.10/dist-packages (from matplotlib->pingouin) (24.1)
Requirement already satisfied: pillow>=6.2.0 in /usr/local/lib/python3.10/dist-packages (from matplotlib->pingouin) (9.4.0)
Requirement already satisfied: pyparsing>=2.3.1 in /usr/local/lib/python3.10/dist-packages (from matplotlib->pingouin) (3.1.
Requirement already satisfied: xarray in /usr/local/lib/python3.10/dist-packages (from pandas-flavor->pingouin) (2023.7.0)
Requirement already satisfied: joblib>=1.1.1 in /usr/local/lib/python3.10/dist-packages (from scikit-learn->pingouin) (1.4.2
Requirement already satisfied: threadpoolctl>=2.0.0 in /usr/local/lib/python3.10/dist-packages (from scikit-learn->pingouin)
Requirement already satisfied: patsy>=0.5.6 in /usr/local/lib/python3.10/dist-packages (from statsmodels->pingouin) (0.5.6)
Requirement already satisfied: six in /usr/local/lib/python3.10/dist-packages (from patsy>=0.5.6->statsmodels->pingouin) (1.
Installing collected packages: pandas-flavor, pingouin
Successfully installed pandas-flavor-0.6.0 pingouin-0.5.4
```

```
import pingouin as pg
```

```
model = pg.anova(data=df, dv='Sales', between=['Location','Flavour'], ss_type=2)
```

```
model
```

	Source	SS	DF	MS	F	p-unc	np2
0	Location	2059.273884	3.0	686.424628	0.390546	0.760092	0.013139
1	Flavour	6919.558981	2.0	3459.779490	1.968465	0.145773	0.042822
2	Location * Flavour	11802.257765	6.0	1967.042961	1.119163	0.357804	0.070897
3	Residual	154669.016331	88.0	1757.602458	NaN	NaN	NaN

KS-Test

```
from scipy import stats
import numpy as np
import matplotlib.pyplot as plt


# recovery times of patients who took medicine-1
r1 = [8.82420842, 7.47774471, 7.55712098, 7.98131439, 6.82771606,
       7.48566433, 9.15385732, 5.84040502, 8.26124313, 8.4728876 ,
       6.82582186, 7.00490974, 8.43423058, 6.72099932, 6.97495982,
       5.93748053, 5.40707847, 6.16385557, 6.71421056, 4.42396183,
       6.87285228, 8.00313581, 6.69035041, 7.83622942, 8.70984957,
       5.56284584, 9.08093437, 4.98165193, 7.67769408, 6.04738478,
       7.64921582, 7.31051639, 6.74463303, 7.27356973, 8.16787232,
       6.90990965, 7.06439167, 6.62921957, 6.08283539, 6.2458137 ,
       8.65173634, 5.76080646, 6.20573219, 8.91561004, 6.22560201,
       5.67542104, 6.97412435, 8.31354697, 8.14172701, 8.26099345,
       7.87612791, 6.24835109, 9.95324783, 6.59504627, 6.17365145,
       6.05676895, 7.23030223, 7.71311809, 7.37163804, 5.69798738,
       5.71056902, 7.94556876, 7.47234105, 6.85346234, 4.77892053,
       6.92631063, 6.10681151, 7.06277198, 7.18023164, 7.78285327,
       7.85500885, 6.54349161, 8.25949958, 6.44289198, 7.16705977,
       6.03517015, 7.61274786, 7.032845  , 6.78161745, 7.07917968,
       6.21549342, 5.34267439, 6.73039933, 7.70562561, 8.15117049,
       6.72564324, 6.68220904, 8.50359274, 7.52912703, 7.34572493,
       5.95734283, 6.58259396, 6.49394335, 8.68069592, 8.60547125,
       6.8905056 , 7.72575925, 6.84801609, 7.96999724, 7.10420915]


# recovery times of patietnts who took medicine-2
r2 = [ 9.56597358,  7.49291458,  8.73841824,  7.63523452,  4.12559277,
        7.3679259 ,  9.87873565,  6.14516559,  8.19923821,  7.30169992,
       10.24606417,  6.83814477,  7.01611267,  6.15716049,  8.29590714,
       12.3333305 ,  8.22144016,  6.06830071,  3.75820649,  6.69220157,
       10.08721618,  9.70580422,  7.31050006, 11.40145721,  5.64818498,
        7.38914449,  8.43740074,  6.3451435 ,  7.05694361,  8.1997151 ,
        9.03059061,  7.76904679,  6.92375578,  5.78318543,  8.99027781,
        7.56186529,  5.27095372,  8.32896688, 11.52935757,  7.08119961,
        9.48825066,  9.14072759,  7.30357663,  8.62183754, 10.40999814,
        8.70096763,  7.04645384,  6.378799  , 10.5098363 ,  7.36078888,
        7.33403615,  8.07396248,  6.18309499,  7.24668404,  9.03430611,
        8.99016584,  6.78606416,  8.436418  ,  6.85877947, 10.10405772,
        6.74943076,  7.57812376,  7.12920671,  9.38065269,  9.57139966,
        6.4484012 ,  6.93877043,  9.22141667,  8.34815638,  7.73980671,
        7.17840767,  9.27913457,  6.49963224,  9.92287292,  7.63978639,
        9.53931977,  9.02602273,  6.79374185,  8.59715131,  8.37747338,
        8.78161815,  6.78716383,  8.28473394,  8.20283798, 12.50518811,
       10.19772574,  8.93758457,  8.9540311 ,  8.28927558,  6.28935098,
        7.69447559,  9.66777701, 10.33898342,  8.71199578,  5.12781581,
        9.70954569,  9.13685031,  7.28989718,  8.0868909 ,  7.42937556,
        7.31356749,  9.92345816,  8.60211814,  9.33228465,  8.14132658,
        6.17871495, 10.28358242,  7.31898597,  7.95085527,  6.20331719,
```

```
        9.19119762,  6.98600628,  7.05314883, 10.57921482,  6.83637574,
        7.86199283,  8.23350975,  5.87625665,  7.78945364,  8.83612492]
```

```
d1 = np.array(r1)
d2 = np.array(r2)
n1 = len(d1)
n2 = len(d2)
n1, n2
```

```
(100, 120)
```

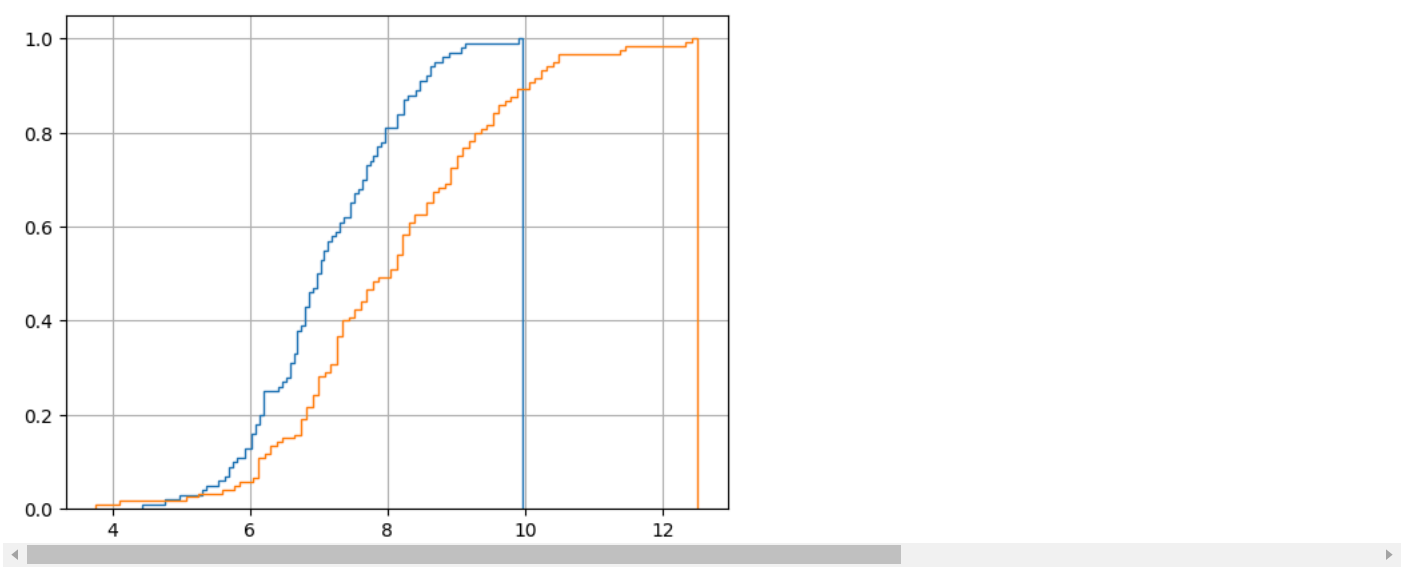
```
stats.kstest(d1,d2)
```

```
KstestResult(statistic=0.3233333333333333, pvalue=1.516338798228849e-05, statistic_location=8.16787232, statistic_sign=1)
```

```
stats.kstest(d2,d1)
```

```
KstestResult(statistic=0.3233333333333333, pvalue=1.516338798228849e-05, statistic_location=8.16787232, statistic_sign=-1)
```

```
plt.grid()
a = plt.hist(d1, bins=100, cumulative=True, label='CDF', density=True, histtype='step')
b = plt.hist(d2, bins=100, cumulative=True, label='CDF', density=True, histtype='step')
plt.show()
```



A/B Testin

```
!wget --no-check-certificate https://drive.google.com/uc?id=1CS513bBqabMfrUhVcqm_nhlgrQheMNZ1 -O ab
```

```
--2024-07-05 17:24:32--  https://drive.google.com/uc?id=1CS513bBqabMfrUhVcqm_nhlgrQheMNZ1
Resolving drive.google.com (drive.google.com)... 74.125.20.100, 74.125.20.113, 74.125.20.102, ...
Connecting to drive.google.com (drive.google.com)|74.125.20.100|:443... connected.
HTTP request sent, awaiting response... 303 See Other
Location: https://drive.usercontent.google.com/download?id=1CS513bBqabMfrUhVcqm_nhlgrQheMNZ1 [following]
--2024-07-05 17:24:32--  https://drive.usercontent.google.com/download?id=1CS513bBqabMfrUhVcqm_nhlgrQheMNZ1
Resolving drive.usercontent.google.com (drive.usercontent.google.com)... 173.194.202.132, 2607:f8b0:400e:c00::84
Connecting to drive.usercontent.google.com (drive.usercontent.google.com)|173.194.202.132|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 883665 (863K) [application/octet-stream]
Saving to: 'ab_test_data.csv'

ab_test_data.csv    100%[===================>] 862.95K  --.-KB/s    in 0.02s

2024-07-05 17:24:34 (40.4 MB/s) - 'ab_test_data.csv' saved [883665/883665]
```

```
ab_test_data = pd.read_csv("ab_test_data.csv")
```

```
ab_test_data.head(10)
```

	date	customer_id	premium	watch_time_hrs	customer_segmnt
0	2018-09-11	402	0	7.173618	control
1	2018-02-28	227	0	0.836170	control
2	2018-10-18	812	1	4.402078	treatment
3	2018-05-22	43	0	3.982454	control
4	2018-07-18	307	0	7.513302	control
5	2018-09-10	238	0	1.456961	control
6	2018-02-21	691	1	3.800375	treatment
7	2018-04-27	199	0	4.574446	control
8	2018-05-28	105	0	3.425942	control
9	2018-09-24	604	0	3.959896	treatment

```
ab_test_data.premium.value_counts()
```

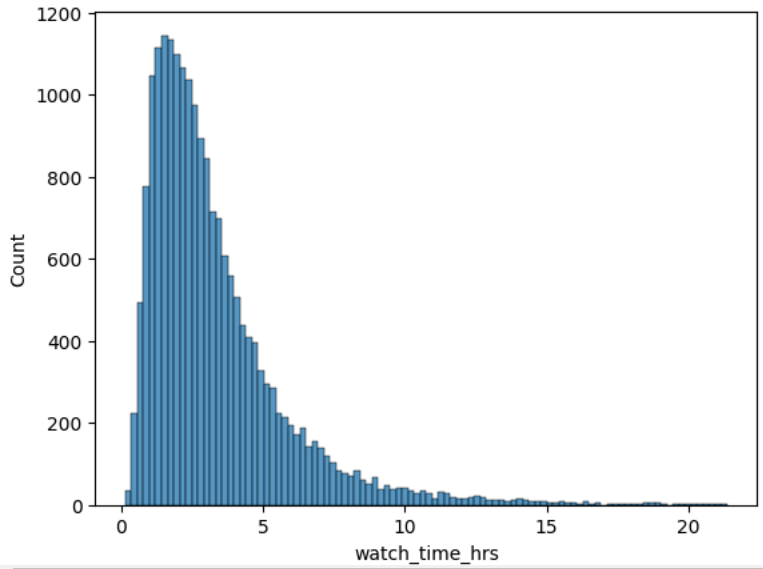
```
premium
0    16434
1     3526
Name: count, dtype: int64
```

```
ab_test_data.customer_segmnt.value_counts()
```

```
customer_segmnt
treatment    9987
control      9973
Name: count, dtype: int64
```

```
import seaborn as sns
```

```
sns.histplot(ab_test_data['watch_time_hrs'], bins=100)
plt.show()
```




```
ab_test_data.groupby("customer_segmnt")["watch_time_hrs"].mean()
```

```
customer_segmnt
control      3.609960
treatment    3.054294
Name: watch_time_hrs, dtype: float64
```

```
ab_test_control_data = ab_test_data[ab_test_data["customer_segmnt"] == "control"]
ab_test_treatment_data = ab_test_data[ab_test_data["customer_segmnt"] == "treatment"]


statistic, p_value = stats.ttest_ind(ab_test_control_data["watch_time_hrs"], ab_test_treatment_data

# The two groups are independent
# So, we'll use the method for independent t-test

print("Test Statistic:", statistic)
print("P-value:", p_value)
```

```
Test Statistic: 15.96034913022092
P-value: 5.438408586231319e-57
```