In [ ]:
```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
```

In [ ]:
```
from scipy.stats import chi2 # Distribution (cdf etc.)
from scipy.stats import chisquare # Statistical test (chistat, pvalue)
from scipy.stats import chi2_contingency # Categorical Vs Categorical
from scipy.stats import ttest_rel,ttest_1samp,ttest_ind
from scipy.stats import binom,tiecorrect
from scipy.stats import f_oneway
```

In [ ]:
```
a = np.array([25, 25, 27, 30, 23, 20])
b = np.array([30, 30, 21, 24, 26, 28])
c = np.array([18, 30, 29, 29, 24, 26])
```

In [ ]:
```
print("a : ", a)
print("b : ", b)
print("c : ", c)
```

```
a :  [25 25 27 30 23 20]
b :  [30 30 21 24 26 28]
c :  [18 30 29 29 24 26]
```

In [ ]:
```
print("Avg(a) :",np.mean(a))
print("Avg(b) :",np.mean(b))
print("Avg(c) :",np.mean(c))
```

```
Avg(a) : 25.0
Avg(b) : 26.5
Avg(c) : 26.0
```

In [ ]:
```
ssb=(6*(25-25.83)**2)+(6*(26.5-25.83)**2)+(6*(26-25.83)**2)
print("ssb :",ssb)
```

```
ssb : 7.0002
```

In [ ]:
```
dof_b= 2
```

In [ ]:
```
msb = ssb/dof_b
print("msb : ",msb)
```

```
msb :  3.5001
```

In [ ]:
```
a-a.mean()
```

In [ ]:
```
ssw=np.sum((a-a.mean())**2)+np.sum((b-b.mean())**2)+np.sum((c-c.mean())**2)
print("ssw :",ssw)
```

```
ssw : 223.5
```

In [ ]:
```
dof_w = 15
```

In [ ]:
```
msw= ssw/dof_w
print("msw : ",msw)
```

```
msw :  14.9
```

In [ ]:
```
f_stat= msb/msw
print("f_stat : ",f_stat)
```

```
f_stat :  0.23499604026845638
```

In [ ]:
```
# Ho : mu1 = mu2 = mu3
# Ha : mu1 != mu2 != mu3

p_value=1-f.cdf(0.234,dfn = 2, dfd=15)


print("p_value : ",p_value)
alpha = 0.05

if p_value<alpha:
    print("Interpretation : Reject Ho")
else:
    print("Interpretation : Fail to Reject Ho")
```

```
p_value :  0.7941969546170948
Interpretation : Fail to Reject Ho
```

In [ ]:
```
f_oneway(a,b,c)
```

Out[ ]:
```
F_onewayResult(statistic=0.2348993288590604, pvalue=0.7935046627323833)
```

In [ ]:
```
# Ho : mu1 = mu2 = mu3
# Ha : mu1 != mu2 != mu3

f_stat,p_value=f_oneway(a,b,c)
print("f_stat : ",f_stat)

print("p_value : ",p_value)
alpha = 0.05

if p_value<alpha:
    print("Interpretation : Reject Ho")
else:
    print("Interpretation : Fail to Reject Ho")
```

```
f_stat :  0.2348993288590604
p_value :  0.7935046627323833
Interpretation : Fail to Reject Ho
```

In [ ]:
```
df=pd.read_csv("/content/aerofit.csv")
df
```

Out[ ]:

	Product	Age	Gender	Education	MaritalStatus	Usage	Fitness	Income	Miles
0	KP281	18	Male	14	Single	3	4	29562	112
1	KP281	19	Male	15	Single	2	3	31836	75
2	KP281	19	Female	14	Partnered	4	3	30699	66
3	KP281	19	Male	12	Single	3	3	32973	85
4	KP281	20	Male	13	Partnered	4	2	35247	47
...	...	...	...	...	...	...	...	...	...
175	KP781	40	Male	21	Single	6	5	83416	200
176	KP781	42	Male	18	Single	5	4	89641	200
177	KP781	45	Male	16	Single	5	5	90886	160
178	KP781	47	Male	18	Partnered	4	5	104581	120
179	KP781	48	Male	18	Partnered	4	5	95508	180

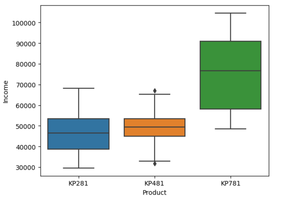
180 rows × 9 columns

In [ ]:
```
df["Product"].value_counts()
```

Out[ ]:
```
KP281    80
KP481    60
KP781    40
Name: Product, dtype: int64
```

In [ ]:
```
sns.boxplot(x="Product",y="Income",data=df)
```

Out[ ]:
```
<Axes: xlabel='Product', ylabel='Income'>
```



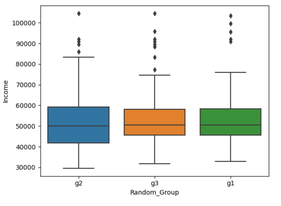
In [ ]:
```
df["Random_Group"] = np.random.choice(["g1","g2","g3"],size=len(df))
```

In [ ]:
```
df["Random_Group"].value_counts()
```

Out[ ]:
```
g3    62
g2    60
g1    58
Name: Random_Group, dtype: int64
```

In [ ]:
```
sns.boxplot(x="Random_Group",y="Income",data=df)
```

Out[ ]:
```
<Axes: xlabel='Random_Group', ylabel='Income'>
```



In [ ]:
```
income_g1 = df.loc[df["Random_Group"]=="g1","Income"]
income_g2 = df.loc[df["Random_Group"]=="g2","Income"]
income_g3 = df.loc[df["Random_Group"]=="g3","Income"]
```

In [ ]:
```
# Ho : mu1 = mu2 = mu3
# Ha : mu1 != mu2 != mu3 ( Atleast one of them is different)

f_stat,p_value=f_oneway(income_g1,income_g2,income_g3)
print("f_stat : ",f_stat)

print("p_value :  ",p_value)
alpha = 0.05

if p_value<alpha:
    print("Interpretation : Reject Ho")
else:
    print("Interpretation : Fail to Reject Ho")
```

```
f_stat :  0.3328005925084164
p_value :  0.7173607582223553
Interpretation : Fail to Reject Ho
```

In [ ]:
```
income_281 = df.loc[df["Product"]=="KP281","Income"]
income_481 = df.loc[df["Product"]=="KP481","Income"]
income_781 = df.loc[df["Product"]=="KP781","Income"]
```

In [ ]:
```
# Ho : mu1 = mu2 = mu3
# Ha : mu1 != mu2 != mu3 ( Atleast one of them is different)

f_stat,p_value=f_oneway(income_281,income_481,income_781)
print("f_stat : ",f_stat)

print("p_value : ",p_value)
alpha = 0.05

if p_value<alpha:
    print("Interpretation : Reject Ho")
else:
    print("Interpretation : Fail to Reject Ho")
```

```
f_stat :  89.25903546601671
p_value :  1.5644991316342494e-27
Interpretation : Reject Ho
```

In [ ]:
```
print("Avg(income_281) :",np.mean(income_281))
print("Avg(income_481) :",np.mean(income_481))
print("Avg(income_781) :",np.mean(income_781))
```

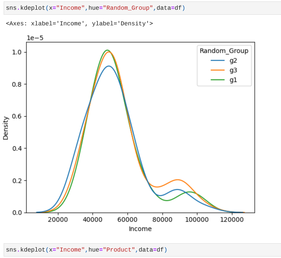
```
Avg(income_281) :  46418.025
Avg(income_481) :  48973.65
Avg(income_781) :  75441.575
```

In [ ]:
```
print("Avg(income_g1) :",np.mean(income_g1))
print("Avg(income_g2) :",np.mean(income_g2))
print("Avg(income_g3) :",np.mean(income_g3))
```

```
Avg(income_g1) :  53741.706896551725
Avg(income_g2) :  52445.166666666664
Avg(income_g3) :  54912.82258064516
```

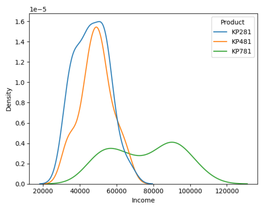
In [ ]:
```
sns.kdeplot(x="Income",hue="Random_Group",data=df)
```

Out[ ]:
```
<Axes: xlabel='Income', ylabel='Density'>
```



In [ ]:
```
sns.kdeplot(x="Income",hue="Product",data=df)
```

Out[ ]:
```
<Axes: xlabel='Income', ylabel='Density'>
```


1e−5
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Density
20000
40000
60000
80000
100000
120000
Income
Product
KP281
KP481
KP781

In [ ]: