Importing Libraries

In [19]:
```python
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
```

In [58]:
```python
from scipy.stats import f,f_oneway,kruskal,ttest_ind,levene,shapiro
```

ANOVA

In [1]:
```python
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 [2]:
```python
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 [4]:
```python
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 [5]:
```python
(6*((25-25.83)**2))+(6*((26.5-25.83)**2))+(6*((26-25.83)**2))
```

Out[5]: 7.0002

In [9]:
```python
np.sum((a-a.mean())**2)+np.sum((b-b.mean())**2)+np.sum((c-c.mean())**2)
```

Out[9]: 223.5

In [10]:
```python
np.sum((a-a.mean())**2)
```

Out[10]: 58.0

In [14]:
```python
p_value=1-f.cdf(0.2348,dfn=2,dfd=15)
print("p_value : ",p_value)
alpha = 0.05
if p_value< alpha:
    print("Interpretation : Reject Ho")
    print("Conclusion : Gender Affects the buying pattern")
else:
    print("Interpretation : Fail to Reject Ho")
```

```
p_value :  0.7935810912142631
Interpretation : Fail to Reject Ho
```

In [17]:
```python
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")
    print("Conclusion : Gender Affects the buying pattern")
else:
    print("Interpretation : Fail to Reject Ho")
```

```
f_stat :  0.2348993288590604
p_value :  0.793504662732833
Interpretation : Fail to Reject Ho
```

Aerofit --> Anova

In [20]:
```python
df=pd.read_csv("aerofit.csv")
df
```

Out[20]:

	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

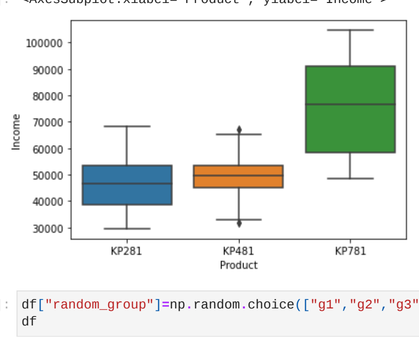
180 rows × 9 columns

In [21]:
```python
df["Product"].unique()
```

Out[21]: array(['KP281', 'KP481', 'KP781'], dtype=object)

In [22]:
```python
sns.boxplot(x="Product",y="Income",data=df)
```

Out[22]: <AxesSubplot:xlabel='Product', ylabel='Income'>



In [31]:
```python
df["random_group"]=np.random.choice(["g1","g2","g3"],size=len(df))
df
```

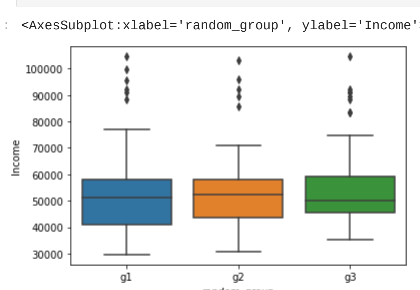
Out[31]:

	Product	Age	Gender	Education	MaritalStatus	Usage	Fitness	Income	Miles	random_group
0	KP281	18	Male	14	Single	3	4	29562	112	g1
1	KP281	19	Male	15	Single	2	3	31836	75	g2
2	KP281	19	Female	14	Partnered	4	3	30699	66	g2
3	KP281	19	Male	12	Single	3	3	32973	85	g2
4	KP281	20	Male	13	Partnered	4	2	35247	47	g1
...	...	...	...	...	...	...	...	...	...	...
175	KP781	40	Male	21	Single	6	5	83416	200	g3
176	KP781	42	Male	18	Single	5	4	89641	200	g2
177	KP781	45	Male	16	Single	5	5	90886	160	g3
178	KP781	47	Male	18	Partnered	4	5	104581	120	g1
179	KP781	48	Male	18	Partnered	4	5	95508	180	g1

180 rows × 10 columns

In [32]:
```python
sns.boxplot(x="random_group",y="Income",data=df)
```

Out[32]: <AxesSubplot:xlabel='random_group', ylabel='Income'>



In [33]:
```python
income_g1 = df[df["random_group"]=="g1"]["Income"]
income_g2 = df[df["random_group"]=="g2"]["Income"]
income_g3 = df[df["random_group"]=="g3"]["Income"]
```

In [34]:
```python
# Ho : All have the same means
# Ha : 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")
    print("Conclusion : Gender Affects the buying pattern")
else:
    print("Interpretation : Fail to Reject Ho")
```

```
f_stat :  0.505206271164861
p_value :  0.6042485016417896
Interpretation : Fail to Reject Ho
```

In [37]:
```python
print("income_g1 Mean :",income_g1.mean())
print("income_g2 Mean :",income_g2.mean())
print("income_g3 Mean :",income_g3.mean())
```

```
income_g1 Mean : 53949.056603773584
income_g2 Mean : 52301.07142857143
income_g3 Mean : 55248.228070175435
```

In [35]:
```python
income_281 = df[df["Product"]=="KP281"]["Income"]
income_481 = df[df["Product"]=="KP481"]["Income"]
income_781 = df[df["Product"]=="KP781"]["Income"]
```

In [36]:
```python
print("income_281 Mean :",income_281.mean())
print("income_481 Mean :",income_481.mean())
print("income_781 Mean :",income_781.mean())
```

```
income_281 Mean : 46418.025
income_481 Mean : 48973.65
income_781 Mean : 75441.575
```

In [38]:
```python
# Ho : All have the same means
# Ha : 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")
    print("Conclusion : Atleast one of them is different")
else:
    print("Interpretation : Fail to Reject Ho")
```

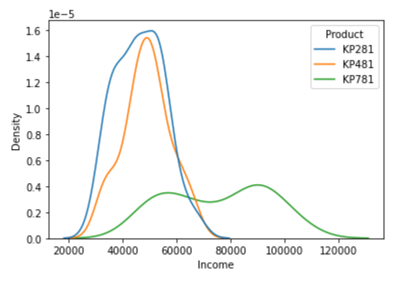
```
f_stat :  89.25903546601671
p_value :  1.5644991316342494e-27
Interpretation : Reject Ho
Conclusion : Atleast one of them is different
```

In [41]:
```python
# Ho : All have the same means
# Ha : Atleast one of them is different
f_stat,p_value=kruskal(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")
    print("Conclusion : Atleast one of them is different")
else:
    print("Interpretation : Fail to Reject Ho")
```

```
f_stat :  61.43670384567185
p_value :  4.562357014275808e-14
Interpretation : Reject Ho
Conclusion : Atleast one of them is different
```

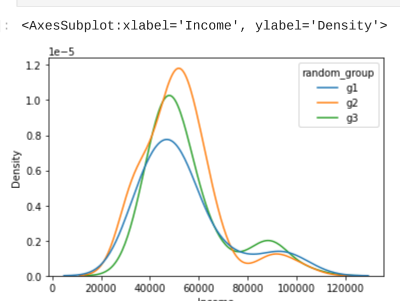
In [42]:
```python
sns.kdeplot(x="Income",hue="Product",data=df)
```

Out[42]: <AxesSubplot:xlabel='Income', ylabel='Density'>



In [43]:
```python
sns.kdeplot(x="Income",hue="random_group",data=df)
```

Out[43]: <AxesSubplot:xlabel='Income', ylabel='Density'>



In [44]:
```python
# Ho : All are similar
# Ha : Atleast one of them is different
f_stat,p_value=kruskal(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")
    print("Conclusion : Atleast one of them is different")
else:
    print("Interpretation : Fail to Reject Ho")
```

```
f_stat :  0.3110749103494736
p_value :  0.8559550163838108
Interpretation : Fail to Reject Ho
```

Levene Test

In [45]:
```python
df1=pd.read_csv("weight-height.csv")
df1
```

Out[45]:

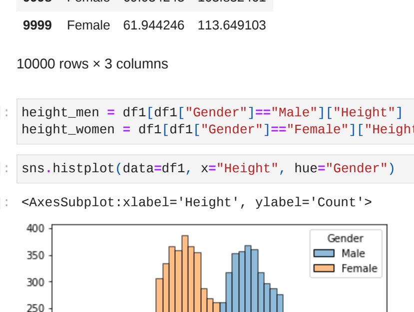
	Gender	Height	Weight
0	Male	73.847017	241.893563
1	Male	68.781904	162.310473
2	Male	74.110105	212.740856
3	Male	71.730978	220.042470
4	Male	69.881796	206.349801
...	...	...	...
9995	Female	66.172652	136.777454
9996	Female	67.067155	170.867906
9997	Female	63.867992	128.475319
9998	Female	69.034243	163.852461
9999	Female	61.944246	113.649103

10000 rows × 3 columns

In [46]:
```python
height_men = df1[df1["Gender"]=="Male"]["Height"]
height_women = df1[df1["Gender"]=="Female"]["Height"]
```

In [47]:
```python
sns.histplot(data=df1, x="Height", hue="Gender")
```

Out[47]: <AxesSubplot:xlabel='Height', ylabel='Count'>



In [ ]:
```python
height_men.mean()
```

Out[ ]: [illegible]

In [ ]:
```python
height_women.mean()
```

Out[ ]: [illegible]

In [ ]:
```python
ttest_ind(height_men,height_women)
```

Out[ ]: Ttest_indResult(statistic=[illegible], pvalue=[illegible])

In [ ]:
```python
height_men.var()
```

Out[ ]: [illegible]

In [ ]:
```python
height_women.var()
```

Out[ ]: [illegible]

In [ ]:
```python
# Ho : Variances are Equal
# Ha : Variances are NOT Equal
v_stat,p_value=levene(height_men,height_women)
print("v_stat : ",v_stat)
print("p_value : ",p_value)
alpha = 0.05
if p_value< alpha:
    print("Interpretation : Reject Ho")
    print("Conclusion : Variances are NOT Equal")
else:
    print("Interpretation : Fail to Reject Ho")
    print("Conclusion : Variances are Equal")
```

```
v_stat : [illegible]
p_value : [illegible]
Interpretation : Reject Ho
Conclusion : Variances are NOT Equal
```

In [ ]:

Wilkin Shapiro Test

Take a few samples generally [50-200]

The test may not work if data points are >50 or Greater >200

In [ ]:
```python
height_sample=df1["Height"].sample(100)
height_sample
```

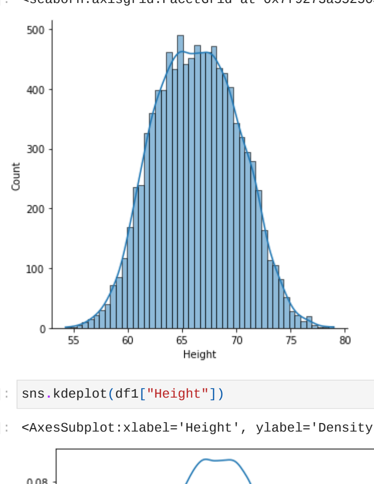
Out[ ]:
```
[illegible]
Name: Height, Length: 100, dtype: float64
```

In [ ]:
```python
# Ho : Data is Gaussian
# Ha : Data is NOT Gaussian
shapiro(height_sample)
```

Out[ ]: ShapiroResult(statistic=[illegible], pvalue=[illegible])

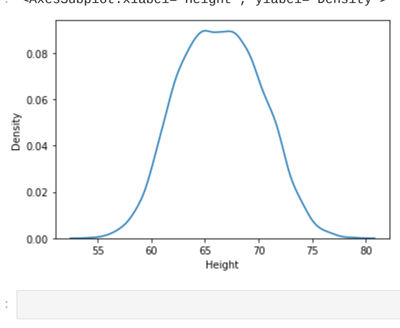
In [ ]:
```python
sns.histplot(df1["Height"],kde=True)
```

Out[ ]: <AxesSubplot:xlabel='Height', ylabel='Count'>



In [62]:
```python
sns.kdeplot(df1["Height"])
```

Out[62]: <AxesSubplot:xlabel='Height', ylabel='Density'>



In [ ]:

Doubts

In [67]:
```python
a = np.array([80,75,82,85,90,82])
b = np.array([57,50,60,65,64,67])
c = np.array([69,71,72,73,66,77])
```

In [68]:
```python
a.mean()
```

Out[68]: 82.33333333333333

In [69]:
```python
b.mean()
```

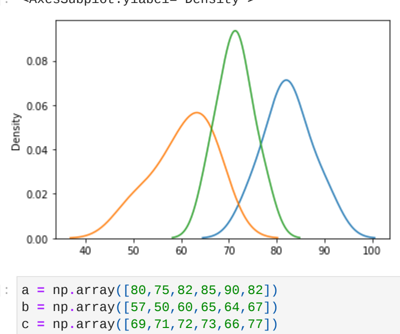
Out[69]: 60.5

In [70]:
```python
c.mean()
```

Out[70]: 71.33333333333333

In [72]:
```python
sns.kdeplot(a)
sns.kdeplot(b)
sns.kdeplot(c)
```

Out[72]: <AxesSubplot:ylabel='Density'>



In [ ]:
```python
a = np.array([80,75,82,85,90,82])
b = np.array([57,50,60,65,64,67])
c = np.array([69,71,72,73,66,77])
```

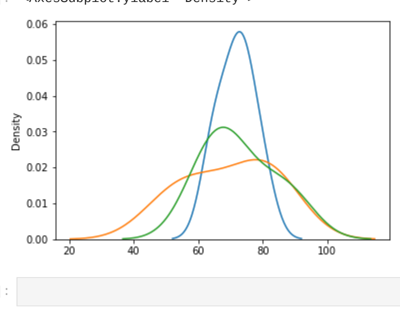
In [73]:
```python
a1 = np.array([80,75,72,73,64,67])
b1 = np.array([57,50,82,85,66,77])
c1 = np.array([69,71,60,65,90,82])
```

In [75]:
```python
print(a1.mean())
print(b1.mean())
print(c1.mean())
```

```
71.83333333333333
69.5
72.83333333333333
```

In [76]:
```python
sns.kdeplot(a1)
sns.kdeplot(b1)
sns.kdeplot(c1)
```

Out[76]: <AxesSubplot:ylabel='Density'>



In [ ]:

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