```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
```

```
df = pd.read_csv("aerofit_treadmill.CSV")
```

```
df
```

	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

```
df.shape
```

```
(180, 9)
```

we have 180 rows and number of columns = 9

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 180 entries, 0 to 179
Data columns (total 9 columns):
 #   Column         Non-Null Count  Dtype
---  ------         --------------  -----
 0   Product        180 non-null    object
 1   Age            180 non-null    int64
 2   Gender         180 non-null    object
 3   Education      180 non-null    int64
 4   MaritalStatus  180 non-null    object
 5   Usage          180 non-null    int64
 6   Fitness        180 non-null    int64
 7   Income         180 non-null    int64
 8   Miles          180 non-null    int64
dtypes: int64(6), object(3)
memory usage: 12.8+ KB
```

```
df.describe(include="all")
```

	Product	Age	Gender	Education	MaritalStatus	Usage	Fitness	Income	Miles
count	180	180.000000	180	180.000000	180	180.000000	180.000000	180.000000	180.000000
unique	3	NaN	2	NaN	2	NaN	NaN	NaN	NaN
top	KP281	NaN	Male	NaN	Partnered	NaN	NaN	NaN	NaN
freq	80	NaN	104	NaN	107	NaN	NaN	NaN	NaN
mean	NaN	28.788889	NaN	15.572222	NaN	3.455556	3.311111	53719.577778	103.194444
std	NaN	6.943498	NaN	1.617055	NaN	1.084797	0.958869	16506.684226	51.863605
min	NaN	18.000000	NaN	12.000000	NaN	2.000000	1.000000	29562.000000	21.000000
25%	NaN	24.000000	NaN	14.000000	NaN	3.000000	3.000000	44058.750000	66.000000
50%	NaN	26.000000	NaN	16.000000	NaN	3.000000	3.000000	50596.500000	94.000000
75%	NaN	33.000000	NaN	16.000000	NaN	4.000000	4.000000	58668.000000	114.750000
max	NaN	50.000000	NaN	21.000000	NaN	7.000000	5.000000	104581.000000	360.000000

```
df[['Income', 'Miles']].describe()
```

	Income	Miles
count	180.000000	180.000000
mean	53719.577778	103.194444
std	16506.684226	51.863605
min	29562.000000	21.000000
25%	44058.750000	66.000000
50%	50596.500000	94.000000
75%	58668.000000	114.750000
max	104581.000000	360.000000

```
df[['Product','Income', 'Miles']].groupby('Product').describe().T
```

	Product	KP281	KP481	KP781
Income	**count**	80.000000	60.000000	40.000000
	mean	46418.025000	48973.650000	75441.575000
	std	9075.783190	8653.989388	18505.836720
	min	29562.000000	31836.000000	48556.000000
	25%	38658.000000	44911.500000	58204.750000
	50%	46617.000000	49459.500000	76568.500000
	75%	53439.000000	53439.000000	90886.000000
	max	68220.000000	67083.000000	104581.000000
Miles	**count**	80.000000	60.000000	40.000000
	mean	82.787500	87.933333	166.900000
	std	28.874102	33.263135	60.066544
	min	38.000000	21.000000	80.000000
	25%	66.000000	64.000000	120.000000
	50%	85.000000	85.000000	160.000000
	75%	94.000000	106.000000	200.000000
	max	188.000000	212.000000	360.000000

```
df.isnull()
```

	Product	Age	Gender	Education	MaritalStatus	Usage	Fitness	Income	Miles
0	False	False	False	False	False	False	False	False	False
1	False	False	False	False	False	False	False	False	False
2	False	False	False	False	False	False	False	False	False
3	False	False	False	False	False	False	False	False	False
4	False	False	False	False	False	False	False	False	False
...	...	...	...	...	...	...	...	...	...
175	False	False	False	False	False	False	False	False	False
176	False	False	False	False	False	False	False	False	False
177	False	False	False	False	False	False	False	False	False
178	False	False	False	False	False	False	False	False	False
179	False	False	False	False	False	False	False	False	False

180 rows × 9 columns

```
df.isnull().any()
```

	0
Product	False
Age	False
Gender	False
Education	False
MaritalStatus	False
Usage	False
Fitness	False
Income	False
Miles	False

dtype: bool

```
df.isnull().sum()/len(df)*100
```

	0
Product	0.0
Age	0.0
Gender	0.0
Education	0.0
MaritalStatus	0.0
Usage	0.0
Fitness	0.0
Income	0.0
Miles	0.0

dtype: float64

None of Columns have missing values.

OBSERVATION FROM THE ABOVE TABLE.

1. There are no missing values in the given data.
2. There are 3 unique product in the dataset.
3. **KP281** is the most frequent product.
4. Minimum & Maximum age of the person is 18 & 50, mean is 28.79 and 75% of persons have age less than or equal to 33.

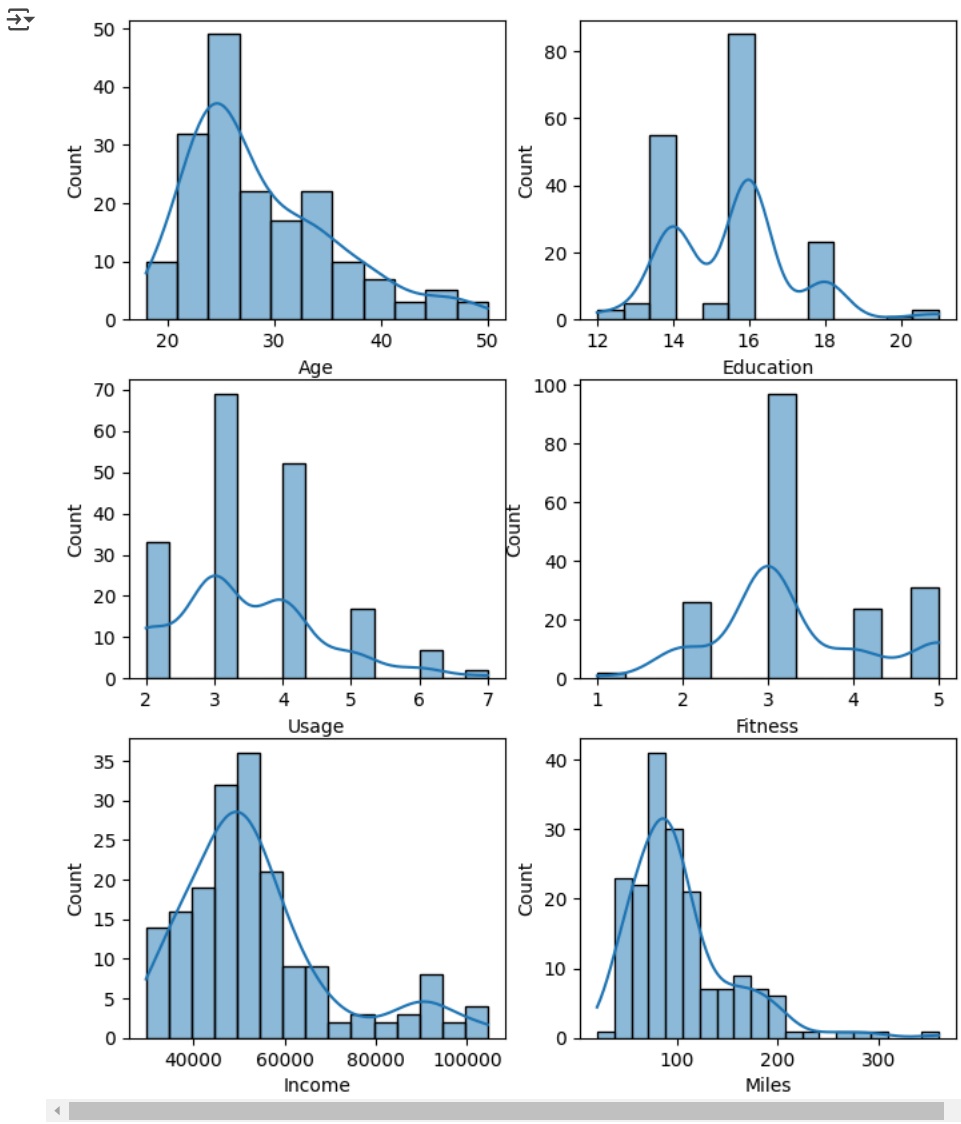
5. Out of 180 data points, 104's gender is Male and rest are female.
6. Most of the people are having 16 years of education i.e., 75% of persons are having educartion <= 16years.
7. Standard devation for Income & Miles is very high. These variables might have the outliers in it .

Univariate Analysis of data:

Understanding the distribution of the data for the quantitative attributes:

1. Age
2. Education
3. Usage
4. Fitness
5. Income
6. Miles

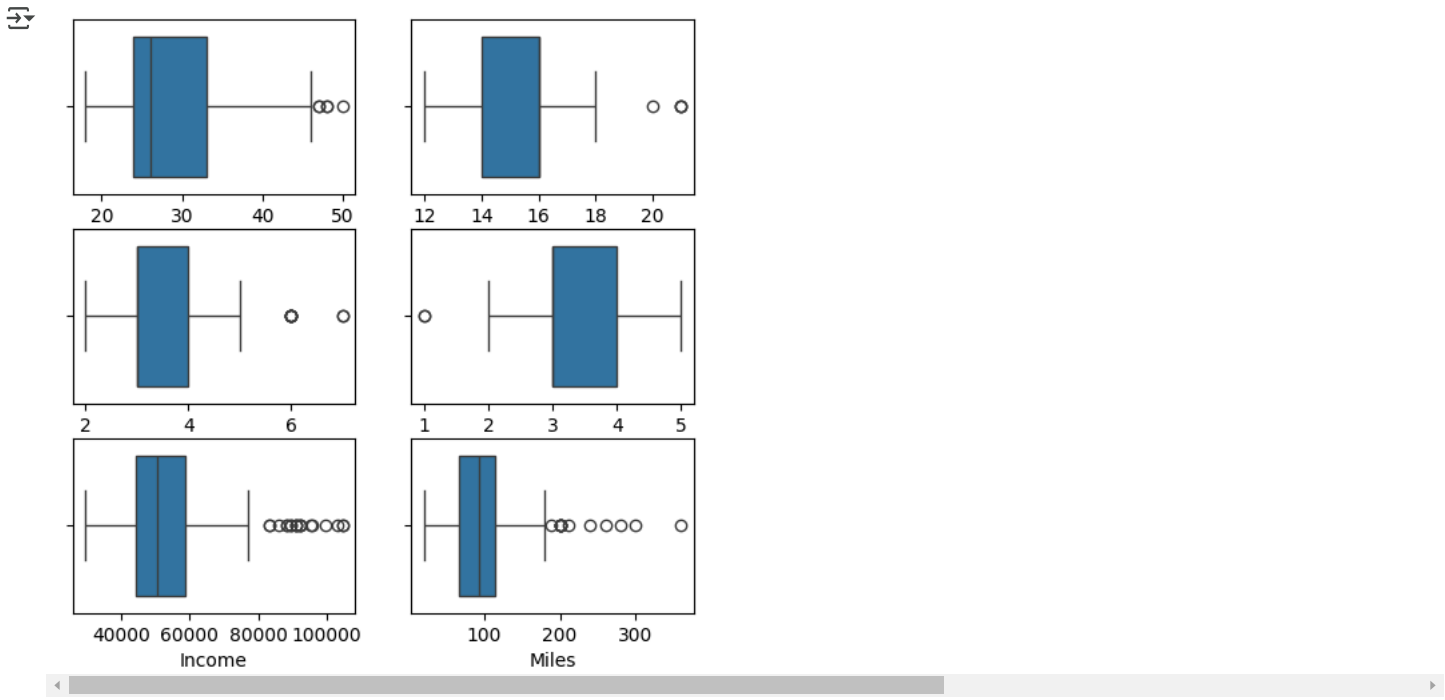
```
draw, axis = plt.subplots(nrows=3, ncols=2, figsize=(8,7))
draw.subplots_adjust(top=1.2)
sns.histplot(df,x="Age",kde=True,ax=axis[0,0])
sns.histplot(df,x="Education",kde=True,ax=axis[0,1])
sns.histplot(df,x="Usage",kde=True,ax=axis[1,0])
sns.histplot(df,x="Fitness",kde=True,ax=axis[1,1])
sns.histplot(df,x="Income",kde=True,ax=axis[2,0])
sns.histplot(df,x="Miles",kde=True,ax=axis[2,1])
plt.show()
```



```
Start coding or generate with AI.
```

Detecting outliers using BoxPlots

```
fig, axis = plt.subplots(nrows=3, ncols=2, figsize=(6, 5))
fig.subplots_adjust(top=1.0)
sns.boxplot(data=df, x="Age", orient='h', ax=axis[0,0])
sns.boxplot(data=df, x="Education", orient='h', ax=axis[0,1])
sns.boxplot(data=df, x="Usage", orient='h', ax=axis[1,0])
sns.boxplot(data=df, x="Fitness", orient='h', ax=axis[1,1])
sns.boxplot(data=df, x="Income", orient='h', ax=axis[2,0])
sns.boxplot(data=df, x="Miles", orient='h', ax=axis[2,1])
plt.show()
```



Observations: Even from the boxplots it is quite clear that:

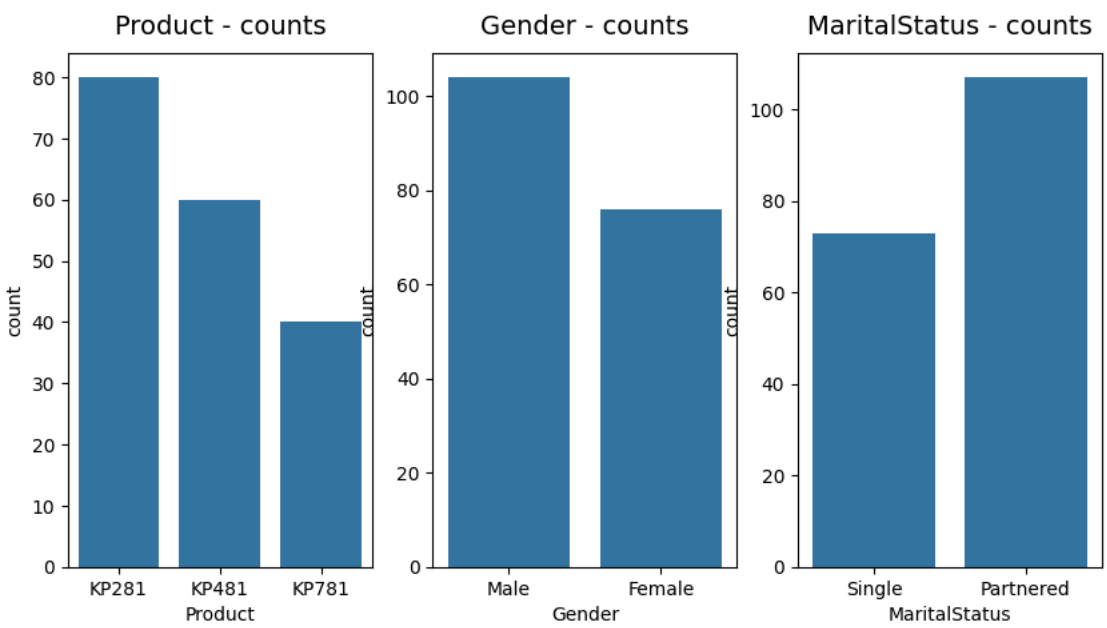
- Age, Education and Usage are having very few outliers.
- While Income and Miles are having more outliers.

Understanding the distribution of the data for the qualitative attributes:

1. Product
2. Gender
3. MaritalStatus

```
fig, axs = plt.subplots(nrows=1, ncols=3, figsize=(10,5))
sns.countplot(data=df, x='Product', ax=axs[0])
sns.countplot(data=df, x='Gender', ax=axs[1])
sns.countplot(data=df, x='MaritalStatus', ax=axs[2])

axs[0].set_title("Product - counts", pad=10, fontsize=14)
axs[1].set_title("Gender - counts", pad=10, fontsize=14)
axs[2].set_title("MaritalStatus - counts", pad=10,
fontsize=14)
plt.show()
```



Observations

- KP281 is the most frequent product.
- There are more Males in the data than Females.
- More Partnered persons are there in the data

To be more precise - and to get the proper analysis of customer who purchased the different product, and the percentage of the purchase of each category.

```
df1 = df[["Product","Gender","MaritalStatus"]].melt()
df1.groupby(["variable","value"])["value"].count()/len(df)
```

		value
variable	value	
Gender	Female	0.422222
	Male	0.577778
MaritalStatus	Partnered	0.594444
	Single	0.405556
Product	KP281	0.444444
	KP481	0.333333
	KP781	0.222222

dtype: float64

Observations

Product

1. 44.44% of the customers have purchased KP2821 product.
2. 33.33% of the customers have purchased KP481 product.
3. 22.22% of the customers have purchased KP781 product

Gender

- 57.78% of the customers are Male.

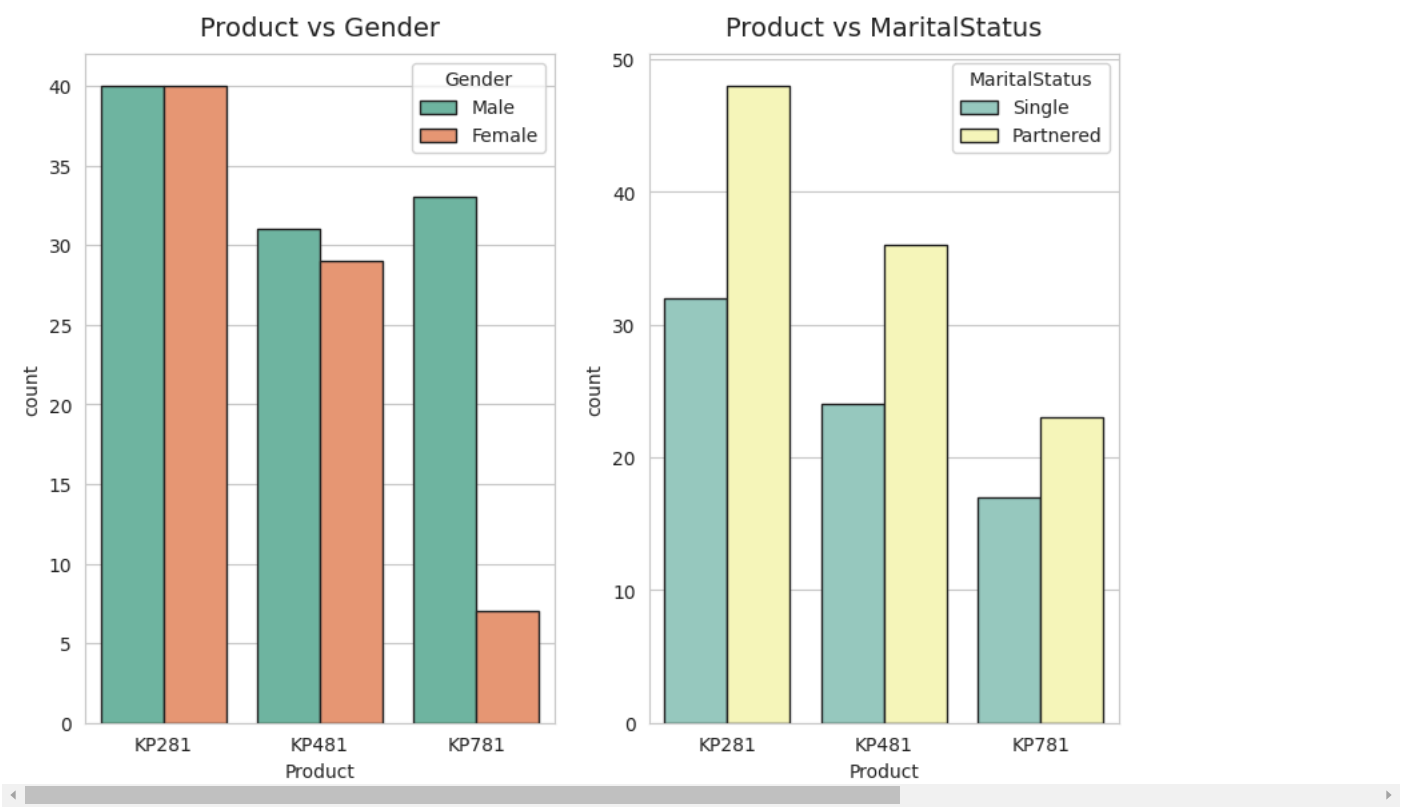
MaritalStatus

- 59.44% of the customers are Partnered.

Bivariate Analysis:

Checking if features - Gender or MaritalStatus have any effect on the product purchased.

```
sns.set_style(style='whitegrid')
fig, axs = plt.subplots(nrows=1, ncols=2, figsize=(10, 6.5))
sns.countplot(data=df, x='Product', hue='Gender', edgecolor="0.15",
palette='Set2', ax=axs[0])
sns.countplot(data=df, x='Product', hue='MaritalStatus',
edgecolor="0.15", palette='Set3', ax=axs[1])
axs[0].set_title("Product vs Gender", pad=10, fontsize=14)
axs[1].set_title("Product vs MaritalStatus", pad=10, fontsize=14)
plt.show()
```



Observations

Product vs Gender

- Equal number of males and females have purchased KP281 product and Almost same for the product KP481
- Most of the Male customers have purchased the KP781 product.

Product vs MaritalStatus

- Customer who is Partnered, is more likely to purchase the product.

Checking if following features have any effect on the product purchased:

1. Age

2. Education
3. Usage
4. Fitness
5. Income
6. Miles

```
attrs = ['Age', 'Education', 'Usage', 'Fitness', 'Income',
'Miles']
sns.set_style("white")
fig, axs = plt.subplots(nrows=2, ncols=3, figsize=(12, 8))
fig.subplots_adjust(top=1.2)
count = 0
for i in range(2):
  for j in range(3):
    sns.boxplot(data=df, x='Product', y=attrs[count],
ax=axs[i,j], palette='Set3')
axs[i,j].set_title(f"Product vs {attrs[count]}",
pad=8, fontsize=13)
count += 1
```

```
<ipython-input-34-d86400db52a8>:9: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `x` variable to `hue` and set `lege

  sns.boxplot(data=df, x='Product', y=attrs[count],
<ipython-input-34-d86400db52a8>:9: FutureWarning:

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<ipython-input-34-d86400db52a8>:9: FutureWarning:

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<ipython-input-34-d86400db52a8>:9: FutureWarning:

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<ipython-input-34-d86400db52a8>:9: FutureWarning:

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  sns.boxplot(data=df, x='Product', y=attrs[count],
```
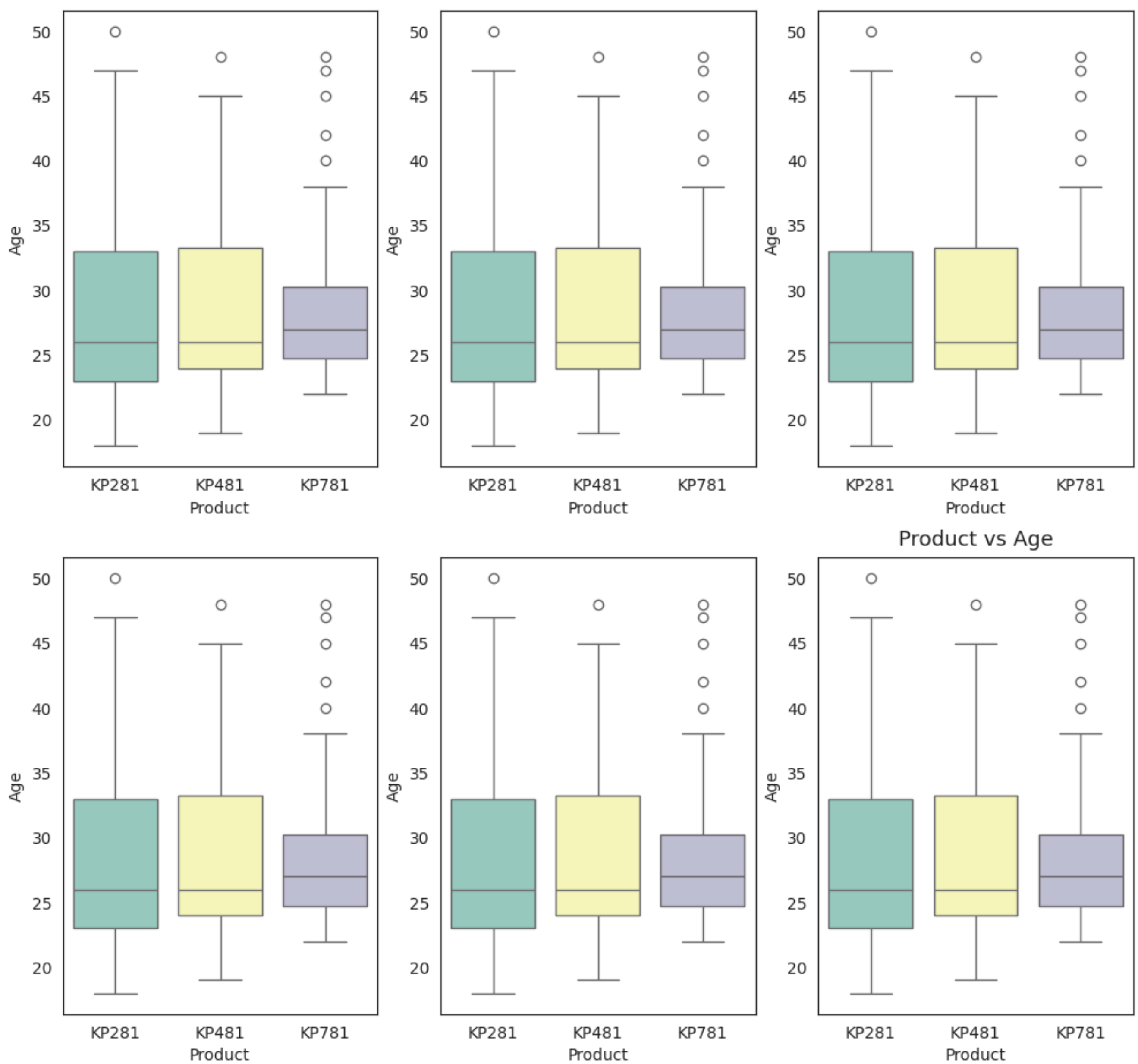



Observations:

1.Product vs Age

- Customers purchasing products KP281 & KP481 are having same Age median value.
- Customers whose age lies between 25-30, are more likely to buy KP781 product.

2. Product vs education

- Customers whose education is greater than 16, have more chances to purchase the KP781 product.
- While the customers with Education less than 16 have equal chances of purchasing KP281 or KP481.

3.Product vs Usage

- Customers who are planning to use the treadmill greater than 4 times a week, are more likely to purchase the KP781 product.
- While the other customers are likely to purchasing KP281 or KP481.

4.Product vs Fitness

- The more the customer is fit (fitness >= 3), higher the chances of the customer to purchase the KP781 product.

5.Product vs Income

- Higher the Income of the customer (Income >= 60000), higher the chances of the customer to purchase the KP781 product.

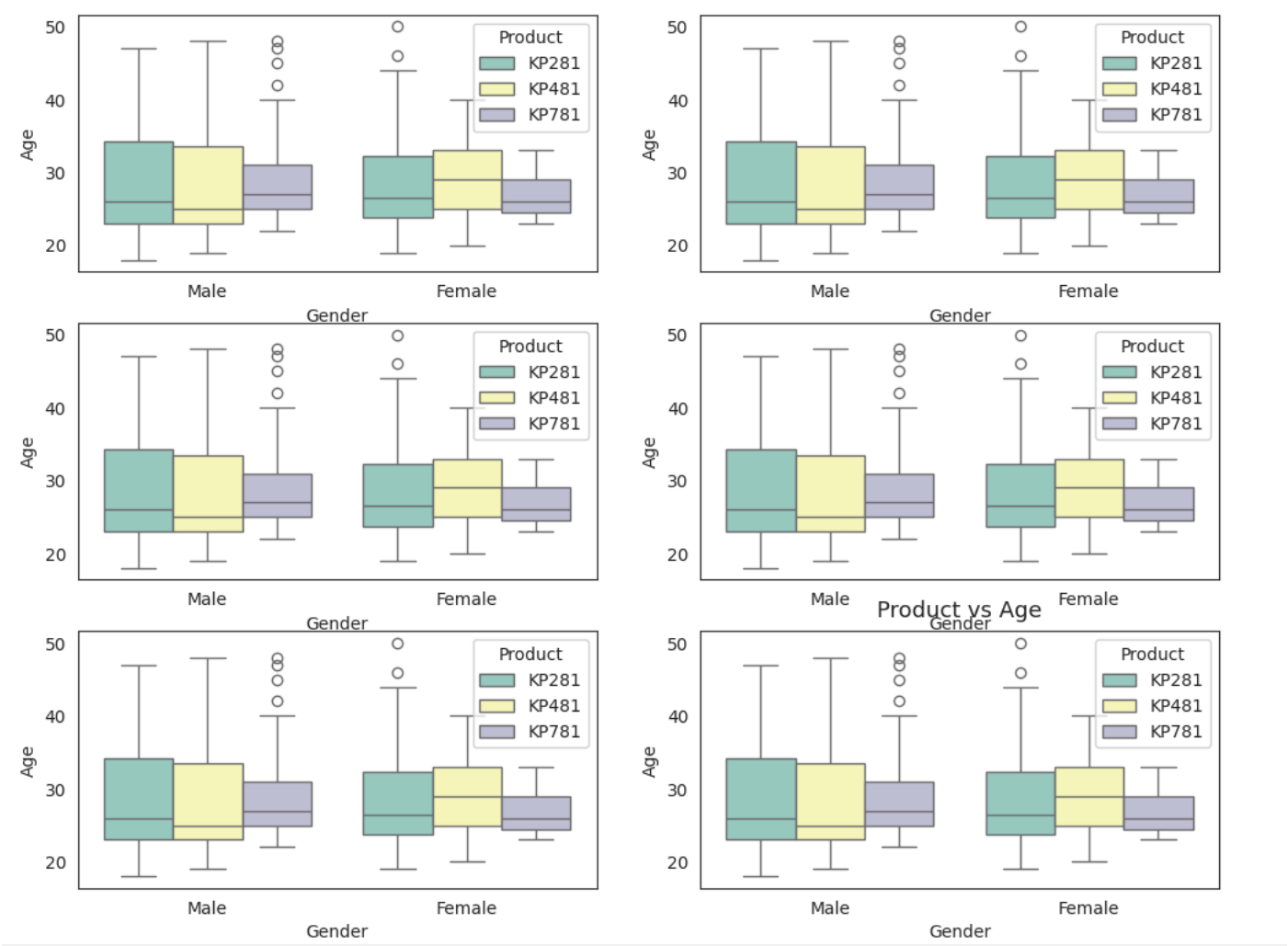
6.Product vs Miles

- If the customer expects to walk/run greater than 120 Miles per week, it is more likely that the customer will buy KP781 product.

Multivariate Analysis

attrs = ['Age', 'Education', 'Usage', 'Fitness', 'Income', 'Miles'] sns.set_style("white") fig, axs = plt.subplots(nrows=3, ncols=2, figsize=(12, 8)) fig.subplots_adjust(top=1) count = 0 for i in range(3): for j in range(2): sns.boxplot(data=df, x='Gender', y=attrs[count], hue='Product', ax=axs[i,j], palette='Set3') axs[i,j].set_title(f"Product vs {attrs[count]}", pad=8, fontsize=13) count += 1

```
attrs = ['Age', 'Education', 'Usage', 'Fitness', 'Income', 'Miles']
sns.set_style("white")
fig, axs = plt.subplots(nrows=3, ncols=2, figsize=(12, 8))
fig.subplots_adjust(top=1)
count = 0
for i in range(3):
  for j in range(2):
    sns.boxplot(data=df, x='Gender', y=attrs[count], hue='Product',
ax=axs[i,j], palette='Set3')
axs[i,j].set_title(f"Product vs {attrs[count]}", pad=8,
fontsize=13)
count += 1
```



Observations

- Females planning to use treadmill 3-4 times a week, are more likely to buy KP481 product.

Computing Marginal & Conditional Probabilities:

- Marginal Probability **bold text**

```
df['Product'].value_counts(normalize=True)
```

Product	proportion
KP281	0.444444
KP481	0.333333
KP781	0.222222

dtype: float64

Conditional Probabilities

Probability of each product given gender:

```
def p_prod_given_gender(gender, print_marginal=False):
  if gender is not "Female" and gender is not "Male":
    return "Invalid gender value."
  df1 = pd.crosstab(index=df['Gender'], columns=[df['Product']])
  p_781 = df1['KP781'][gender] / df1.loc[gender].sum()
  p_481 = df1['KP481'][gender] / df1.loc[gender].sum()
  p_281 = df1['KP281'][gender] / df1.loc[gender].sum()
  if print_marginal:
    print(f"P(Male): {df1.loc['Male'].sum()/len(df):.2f}")
    print(f"P(Female): {df1.loc['Female'].sum()/len(df):.2f}\n")
  print(f"P(KP781/{gender}): {p_781:.2f}")
  print(f"P(KP481/{gender}): {p_481:.2f}")
  print(f"P(KP281/{gender}): {p_281:.2f}\n")
p_prod_given_gender('Male', True)
p_prod_given_gender('Female')
```

```
P(Male): 0.58
P(Female): 0.42

P(KP781/Male): 0.32
P(KP481/Male): 0.30
P(KP281/Male): 0.38

P(KP781/Female): 0.09
P(KP481/Female): 0.38
P(KP281/Female): 0.53

<>:2: SyntaxWarning: "is not" with a literal. Did you mean "!="?
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<ipython-input-48-a583626effe2>:2: SyntaxWarning: "is not" with a literal. Did you mean "!="?
  if gender is not "Female" and gender is not "Male":
<ipython-input-48-a583626effe2>:2: SyntaxWarning: "is not" with a literal. Did you mean "!="?
  if gender is not "Female" and gender is not "Male":
```

```
pd.crosstab(index=df['Gender'], columns=df['Product'])
```

Product	KP281	KP481	KP781
Gender			
Female	40	29	7