Calories Burnt Prediction Regression Model

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- **Objective**: The primary goal of the model is to accurately predict the calorie expenditure (calories burnt) by individuals during physical activities
- **Model Type** : The model is a regression model, specifically designed for continuous target variables, such as calorie counts.
- **Features**: The model utilizes various input features (independent variables) such as gender, age, height, weight, duration of exercise, heart rate, and body temperature to make predictions.
- **Development**: The model is developed using Python programming language within a Google colad notebook environment. Libraries such as pandas, scikit-learn, and XGBoost are likely used for data manipulation, model building, and evaluation.
- **Training and Evaluation**: The model is trained on a dataset that contains historical records of individuals' characteristics and corresponding calorie expenditures. Evaluation metrics such as Mean Absolute Error (mae) and R-squared value are likely used to assess the model's performance.
- **Interpretation**: The model's predictions can provide valuable insights into the factors influencing calorie expenditure during physical activities. It can help individuals and professionals in fields such as fitness, healthcare, and sports performance to better understand and optimize their exercise routines.

In [408…

```
# Mount Google Drive
from google.colab import drive
drive.mount('/content/drive', force_remount=True)
```

```
Mounted at /content/drive
```

Importing the Dependencies

In [409…

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
from xgboost import XGBRegressor
from sklearn import metrics
from sklearn.metrics import r2_score
```

Data Importing & Data Pre-Processing

In [410…
```
# loading th data from CSV file to pandas Dataframe
calories = pd.read_csv('/content/drive/MyDrive/Colab Notebooks/calories.csv')
```

In [411…
```
# print first 5 rows of the dataframe
calories.head()
```

Out[411]:

	User_ID	Calories
0	14733363	231.0
1	14861698	66.0
2	11179863	26.0
3	16180408	71.0
4	17771927	35.0

In [412…
```
exercise = pd.read_csv('/content/drive/MyDrive/Colab Notebooks/exercise.csv')
```

In [413…
```
exercise.head()
```

Out[413]:

	User_ID	Gender	Age	Height	Weight	Duration	Heart_Rate	Body_Temp
0	14733363	male	68	190.0	94.0	29.0	105.0	40.8
1	14861698	female	20	166.0	60.0	14.0	94.0	40.3
2	11179863	male	69	179.0	79.0	5.0	88.0	38.7
3	16180408	female	34	179.0	71.0	13.0	100.0	40.5
4	17771927	female	27	154.0	58.0	10.0	81.0	39.8

In [414…
```
#Combining the calorie and exercise dataframes
df = pd.concat([exercise, calories['Calories']],axis=1)
```

In [415…
```
df.head()
```

Out[415]:

	User_ID	Gender	Age	Height	Weight	Duration	Heart_Rate	Body_Temp	Calories
0	14733363	male	68	190.0	94.0	29.0	105.0	40.8	231.0
1	14861698	female	20	166.0	60.0	14.0	94.0	40.3	66.0
2	11179863	male	69	179.0	79.0	5.0	88.0	38.7	26.0
3	16180408	female	34	179.0	71.0	13.0	100.0	40.5	71.0
4	17771927	female	27	154.0	58.0	10.0	81.0	39.8	35.0

In [416…

```
# check the numbers of rows and columns in df dataframe
df.shape
```

Out[416]:

```
(15000, 9)
```

In [417…

```
# checking some important information about this dataframe
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 15000 entries, 0 to 14999
Data columns (total 9 columns):
 #   Column      Non-Null Count  Dtype  
---  ------      --------------  -----  
 0   User_ID     15000 non-null  int64  
 1   Gender      15000 non-null  object 
 2   Age         15000 non-null  int64  
 3   Height      15000 non-null  float64
 4   Weight      15000 non-null  float64
 5   Duration    15000 non-null  float64
 6   Heart_Rate  15000 non-null  float64
 7   Body_Temp   15000 non-null  float64
 8   Calories    15000 non-null  float64
dtypes: float64(6), int64(2), object(1)
memory usage: 1.0+ MB
```

In [418…

```
# checking missing values
df.isnull().sum()
```

Out[418]:

```
User_ID       0
Gender        0
Age           0
Height        0
Weight        0
Duration      0
Heart_Rate    0
Body_Temp     0
Calories      0
dtype: int64
```

There is no missing values in this dataset. In the data preprocrssing part we concatonate the two dataframe into one dataframe.Now let's go to the data Analysis part.

Data Analysis

In [419…

```
# get statistical measurment description about the dataframe
df.describe()
```

Out[419]:

	User_ID	Age	Height	Weight	Duration	Heart_Rate	Body_Temp	Calories
count	1.500000e+04	15000.000000	15000.000000	15000.000000	15000.000000	15000.000000	15000.000000	15000.000000
mean	1.497736e+07	42.789800	174.465133	74.966867	15.530600	95.518533	40.025453	89.539533
std	2.872851e+06	16.980264	14.258114	15.035657	8.319203	9.583328	0.779230	62.456978
min	1.000116e+07	20.000000	123.000000	36.000000	1.000000	67.000000	37.100000	1.000000
25%	1.247419e+07	28.000000	164.000000	63.000000	8.000000	88.000000	39.600000	35.000000
50%	1.499728e+07	39.000000	175.000000	74.000000	16.000000	96.000000	40.200000	79.000000
75%	1.744928e+07	56.000000	185.000000	87.000000	23.000000	103.000000	40.600000	138.000000
max	1.999965e+07	79.000000	222.000000	132.000000	30.000000	128.000000	41.500000	314.000000

Data Visualization

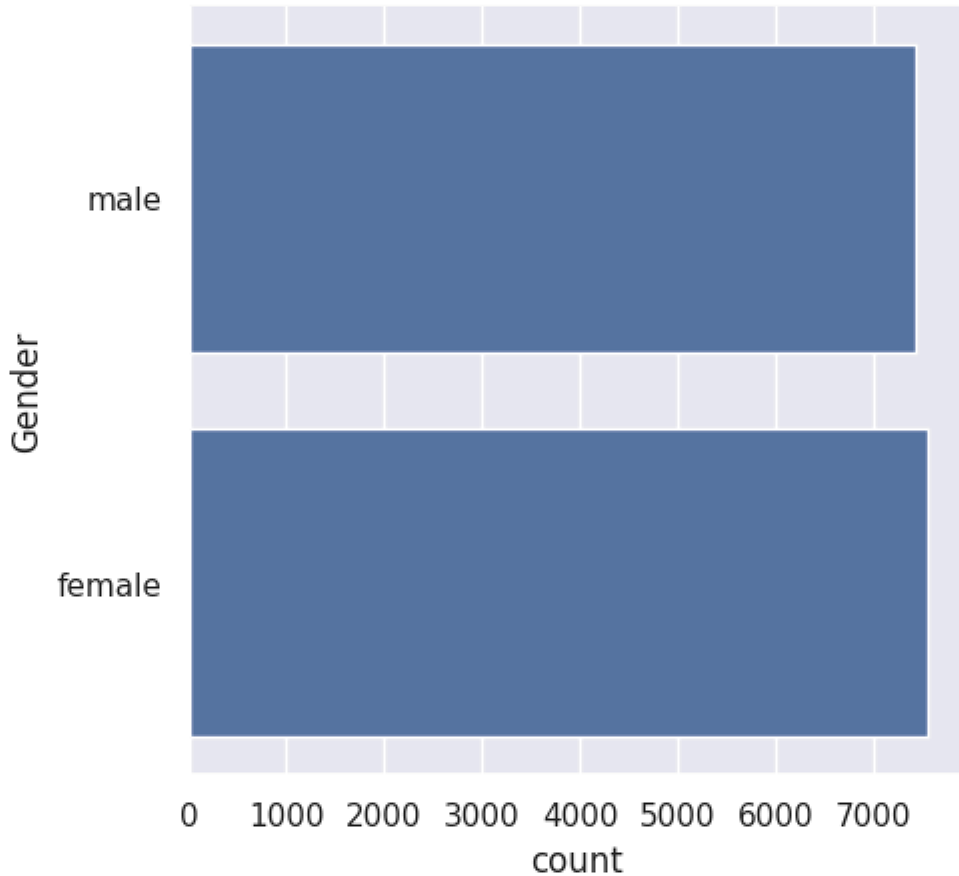
In [420…

```
sns.set()
```

In [421…

```
#plot the gender variable (categorical)
plt.figure(figsize=(5,5))
sns.countplot(df['Gender'])
```

Out[421]:
```
<Axes: xlabel='count', ylabel='Gender'>
```

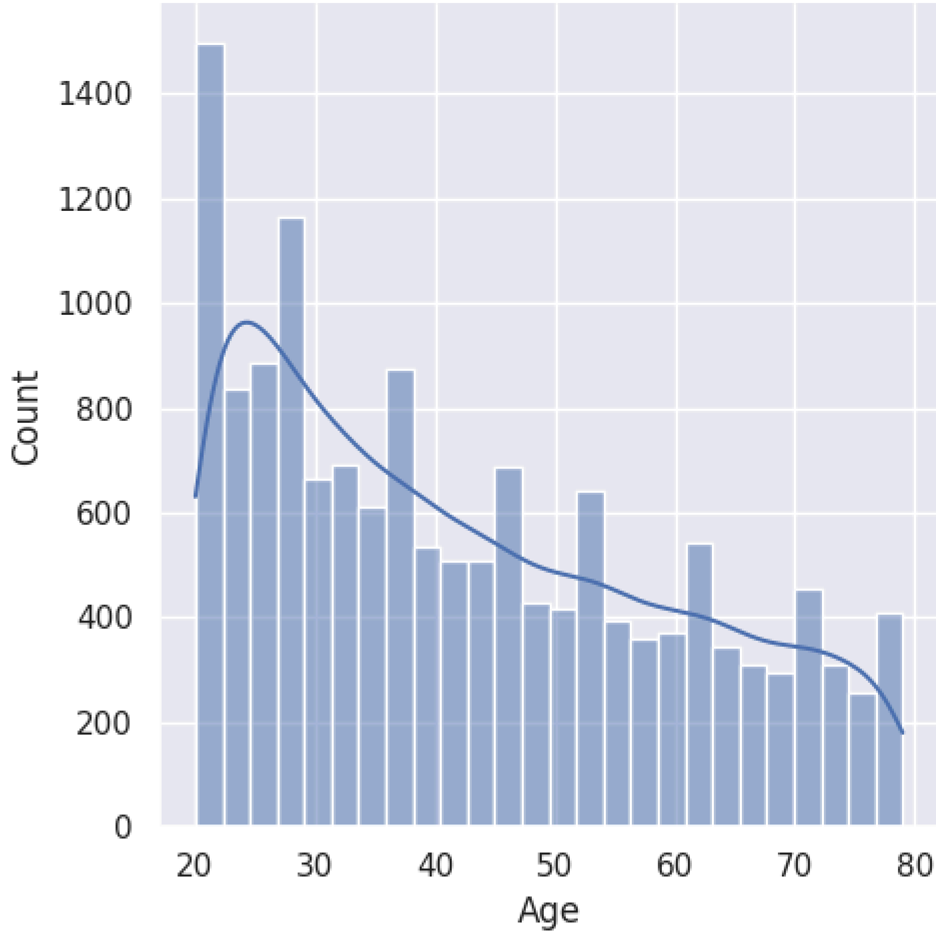


We can see that male and female count is approxiamtely equal in above count plot. So the distribution of gender is good in our dataset.

In [422…
```
#finding the distribution of age variable(quantitative)
plt.figure(figsize=(5,5))
sns.displot(df['Age'],kde=True)
```

Out[422]:
```
<seaborn.axisgrid.FacetGrid at 0x78a129e1dea0>
```

```
<Figure size 500x500 with 0 Axes>
```

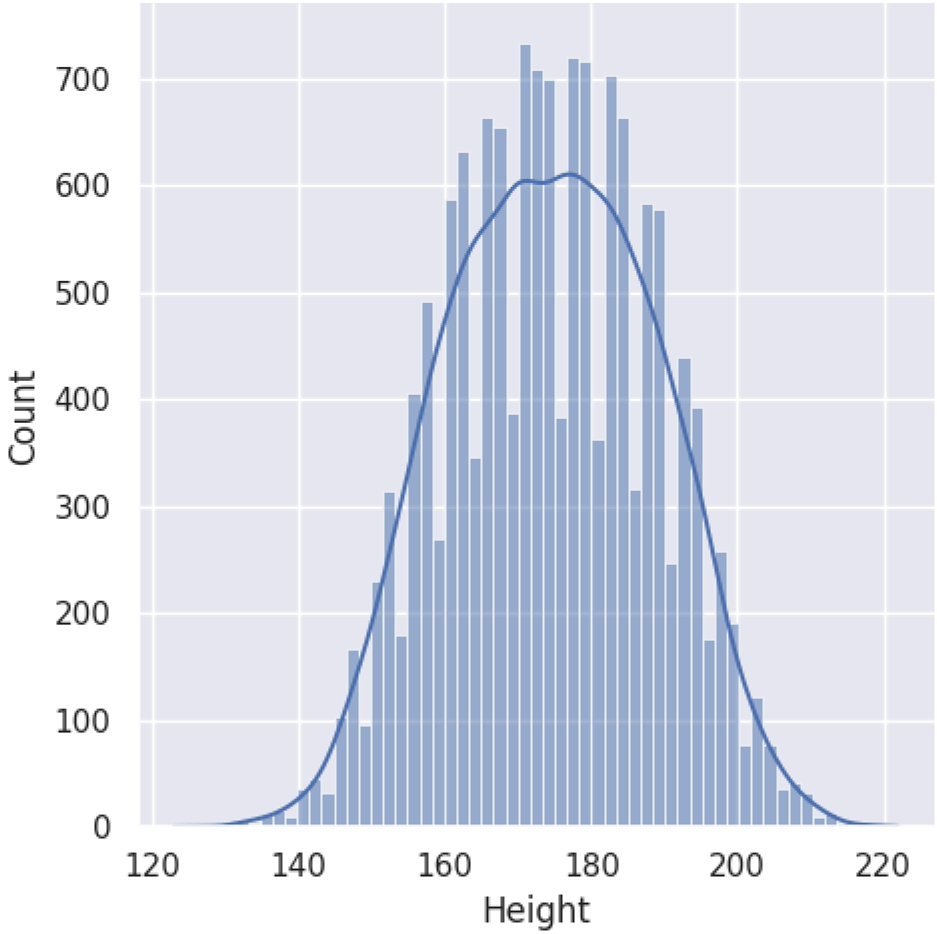


In [423…

```
#finding the distribution of height variable(quantitative)
plt.figure(figsize=(5,5))
sns.displot(df['Height'],kde=True)
```

Out[423]:

```
<seaborn.axisgrid.FacetGrid at 0x78a128ee99f0>
<Figure size 500x500 with 0 Axes>
```



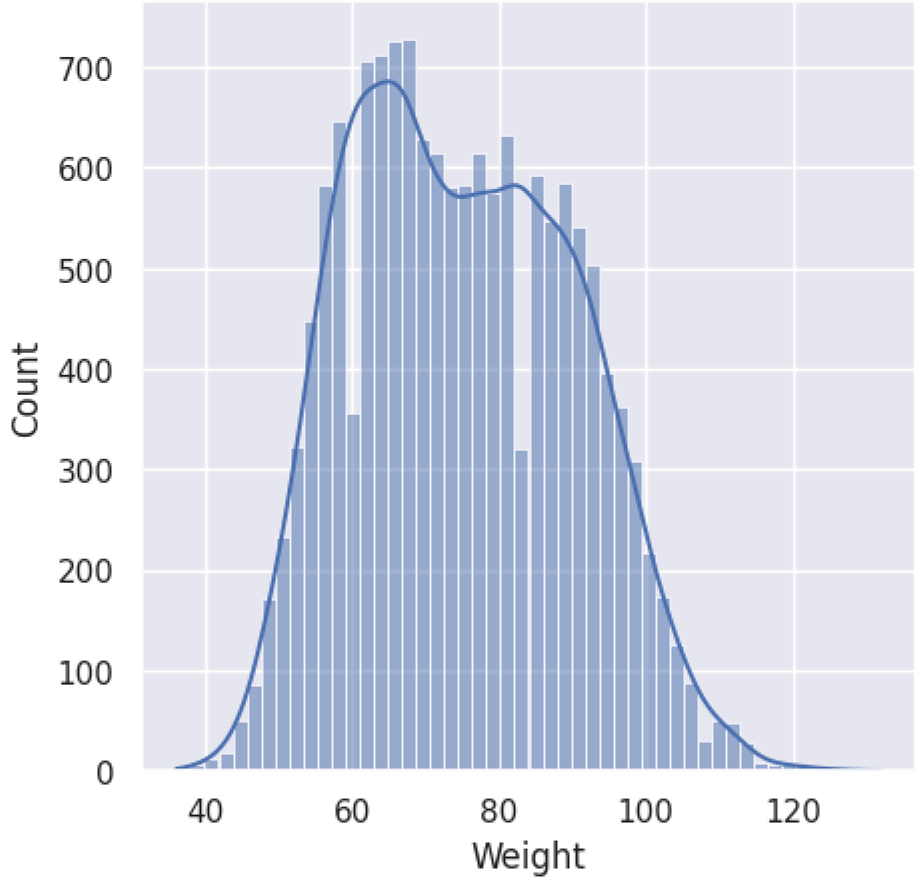
Height distribution exhibits normality.

In [424…

```
#finding the distribution of weight variable(quantitative)
plt.figure(figsize=(5,5))
sns.histplot(df['Weight'],kde=True)
```

Out[424]:

```
<Axes: xlabel='Weight', ylabel='Count'>
```



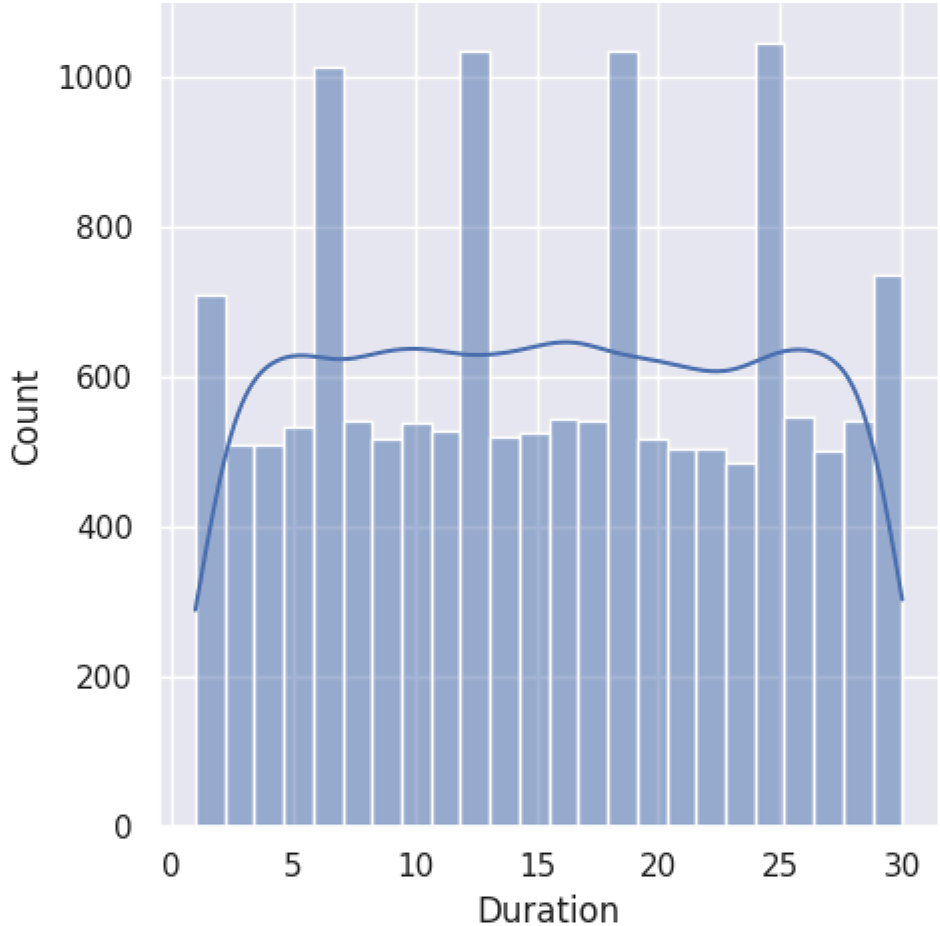
In [425…

```
#finding the distribution of duration variable(quantitative)
plt.figure(figsize=(5,5))
sns.displot(df['Duration'],kde=True)
```

Out[425]:

```
<seaborn.axisgrid.FacetGrid at 0x78a128b10970>
```

```
<Figure size 500x500 with 0 Axes>
```



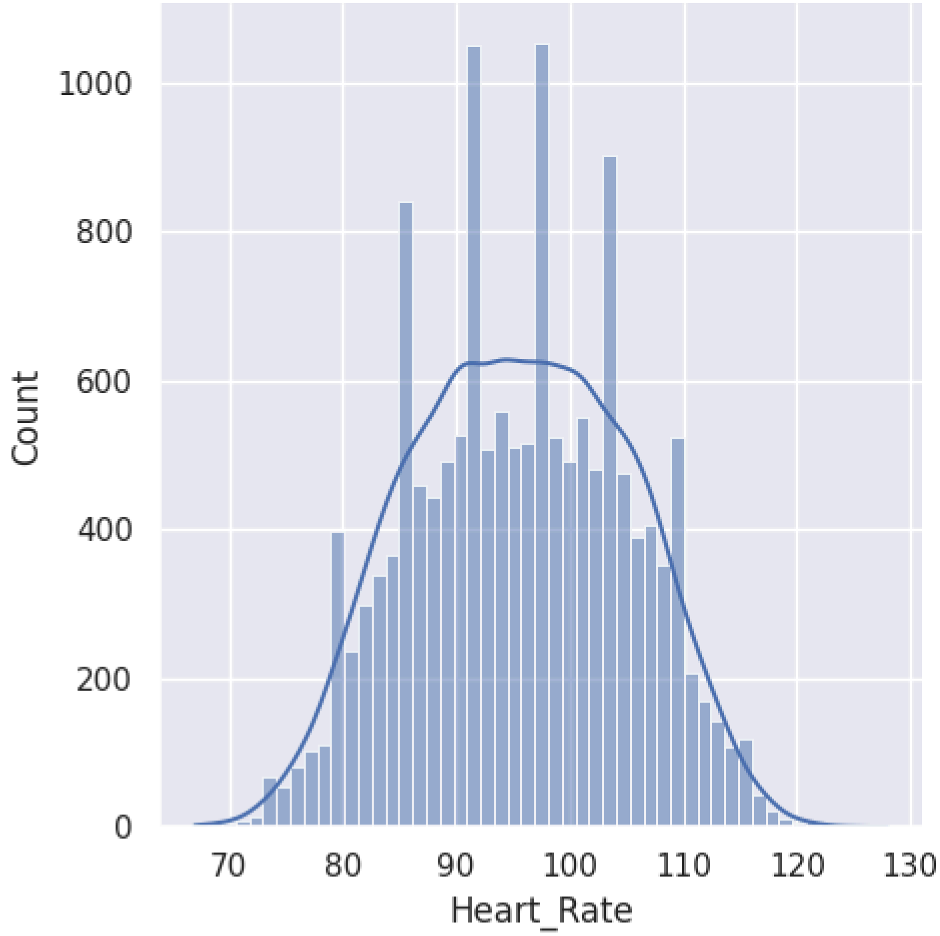
In [426…

```
#finding the distribution of heart rate variable(quantitative)
plt.figure(figsize=(5,5))
sns.displot(df['Heart_Rate'],kde=True)
```

Out[426]:

```
<seaborn.axisgrid.FacetGrid at 0x78a128bb4d30>

<Figure size 500x500 with 0 Axes>
```



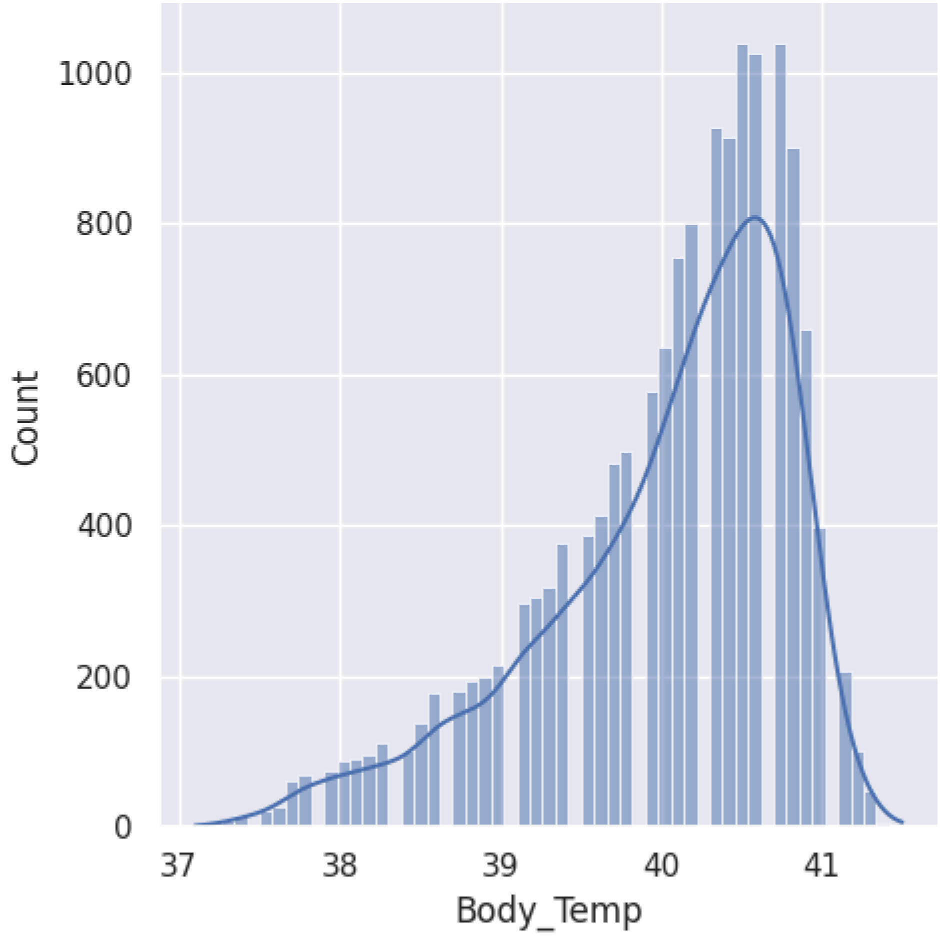
In [427…

```
#finding the distribution of body temperature variable(quantitative)
plt.figure(figsize=(5,5))
sns.displot(df['Body_Temp'],kde=True)
```

Out[427]:

```
<seaborn.axisgrid.FacetGrid at 0x78a128a6b0a0>

<Figure size 500x500 with 0 Axes>
```



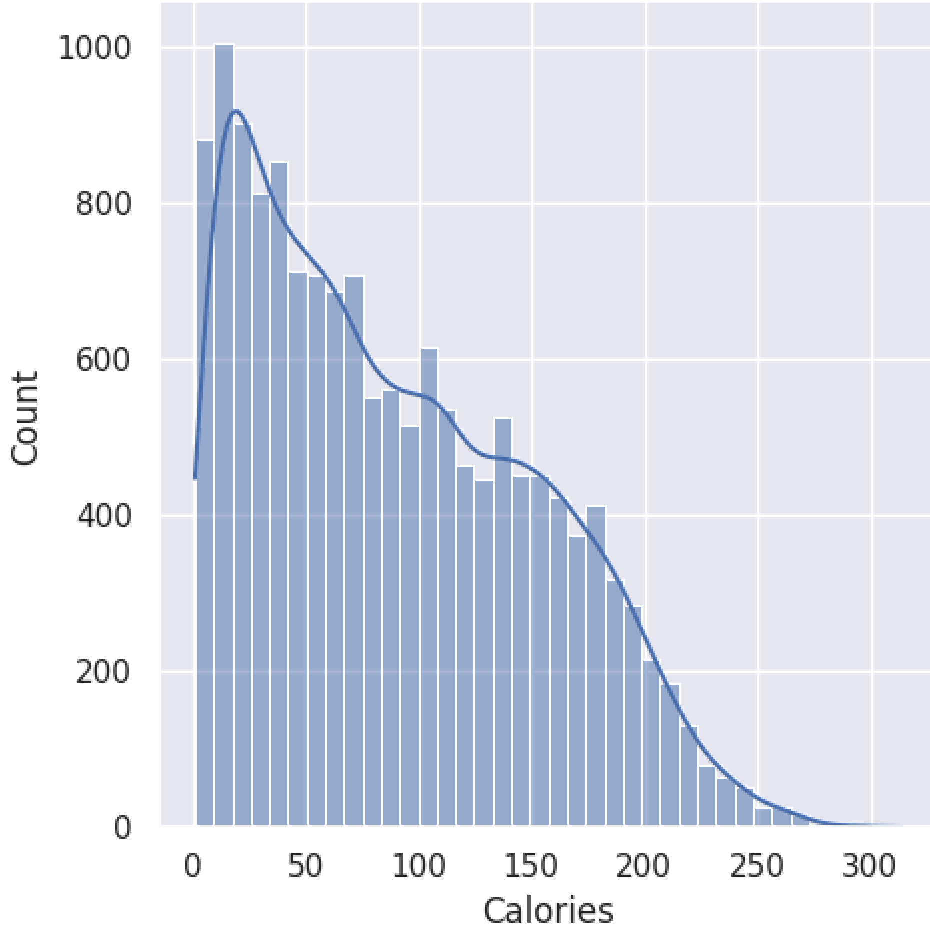
In [428…

```
#finding the distribution of calories variable(quantitative)
plt.figure(figsize=(5,5))
sns.displot(df['Calories'],kde=True)
```

Out[428]:

```
<seaborn.axisgrid.FacetGrid at 0x78a128906350>

<Figure size 500x500 with 0 Axes>
```



Find the correlations of variables

1. Positive Correlation
2. Negative Correlation

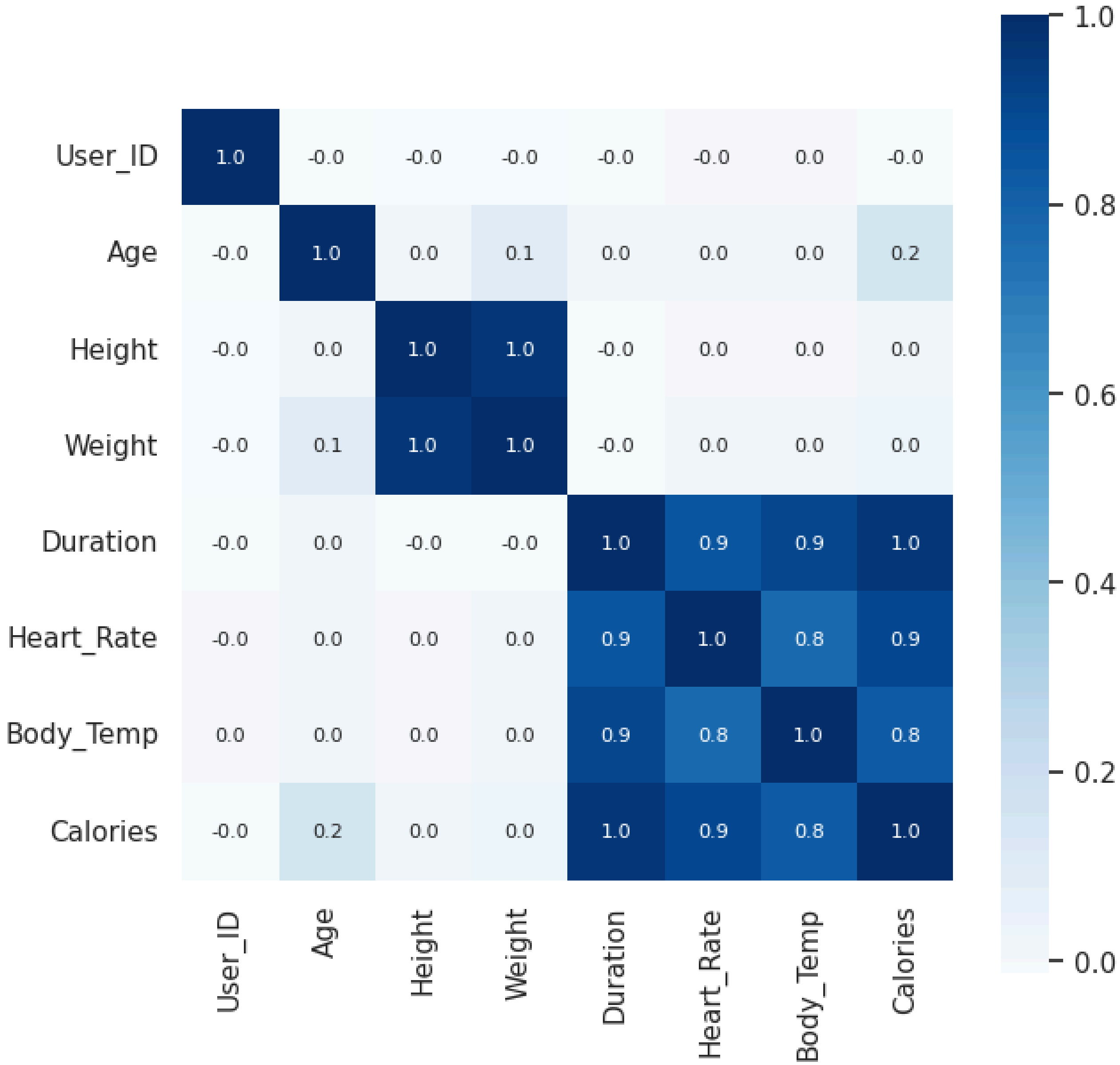
In [429…

```
# Drop the 'gender' column
df_without_gender = df.drop(columns=['Gender'],axis=1)
correlation = df_without_gender.corr()
```

In [430…

```
#plotting heatmap to understand correlation
plt.figure(figsize=(7,7))
sns.heatmap(correlation,cbar=True,square=True,fmt='.1f',annot=True,annot_kws={'size':8},cmap='Blues')
```

```
Out[430]: <Axes: >
```



1. duration, heart rate, body tempureature positively correlated with calories,when they increaese the caloreies are also increases.
2. calories and weight is negatively correlated with age variable.

As 'Duration' and 'Calories' have a correlation coefficient of 1, it indicates a perfect linear relationship, making 'Duration' unnecessary for estimating the use of calories.

Feature Encoding

Text data (e.g., gender) is converted into numerical values for modeling purposes.

In [431…
```
df.replace({"Gender": {'male': 0, 'female': 1}}, inplace=True)
```

In [432…
```
df.head()
```

Out[432]:

	User_ID	Gender	Age	Height	Weight	Duration	Heart_Rate	Body_Temp	Calories
0	14733363	0	68	190.0	94.0	29.0	105.0	40.8	231.0
1	14861698	1	20	166.0	60.0	14.0	94.0	40.3	66.0
2	11179863	0	69	179.0	79.0	5.0	88.0	38.7	26.0
3	16180408	1	34	179.0	71.0	13.0	100.0	40.5	71.0
4	17771927	1	27	154.0	58.0	10.0	81.0	39.8	35.0

Seperating features and Targets

In [433…
```
X = df.drop(columns=['User_ID','Calories'],axis=1)
Y = df['Calories']
```

In [434…
```
print(X) #features
```

```
       Gender  Age  Height  Weight  Duration  Heart_Rate  Body_Temp
0           0   68   190.0    94.0      29.0       105.0       40.8
1           1   20   166.0    60.0      14.0        94.0       40.3
2           0   69   179.0    79.0       5.0        88.0       38.7
3           1   34   179.0    71.0      13.0       100.0       40.5
4           1   27   154.0    58.0      10.0        81.0       39.8
...       ...  ...     ...     ...       ...         ...        ...
14995       1   20   193.0    86.0      11.0        92.0       40.4
14996       1   27   165.0    65.0       6.0        85.0       39.2
14997       1   43   159.0    58.0      16.0        90.0       40.1
14998       0   78   193.0    97.0       2.0        84.0       38.3
14999       0   63   173.0    79.0      18.0        92.0       40.5

[15000 rows x 7 columns]
```

In [435…

```
print(Y) #target
```

```
0        231.0
1         66.0
2         26.0
3         71.0
4         35.0
         ...
14995     45.0
14996     23.0
14997     75.0
14998     11.0
14999     98.0
Name: Calories, Length: 15000, dtype: float64
```

Data Splitting

The dataset is split into training and testing sets using the train_test_split function from scikit-learn.

In [436…

```
X_train ,X_test ,Y_train ,Y_test = train_test_split(X, Y, test_size=0.1, random_state=2) #10% test data and 90% train d
```

In [437…

```
print(X.shape,X_train.shape,X_test.shape)
```

```
(15000, 7) (13500, 7) (1500, 7)
```

Model Training & Evaluation

An XGBoost regression model is trained on the training data and evaluated using Mean Absolute Error (MAE) and R-squared value metrics.

XG Boost Regressor

In [438…
```
#loading the ML model
model = XGBRegressor()
```

In [439…
```
#This line of code trains your ML model using the training data
model.fit(X_train,Y_train)
```

Out[439]:
```
XGBRegressor
XGBRegressor(base_score=None, booster=None, callbacks=None,
             colsample_bylevel=None, colsample_bynode=None,
             colsample_bytree=None, device=None, early_stopping_rounds=None,
             enable_categorical=False, eval_metric=None, feature_types=None,
             gamma=None, grow_policy=None, importance_type=None,
             interaction_constraints=None, learning_rate=None, max_bin=None,
             max_cat_threshold=None, max_cat_to_onehot=None,
             max_delta_step=None, max_depth=None, max_leaves=None,
             min_child_weight=None, missing=nan, monotone_constraints=None,
             multi_strategy=None, n_estimators=None, n_jobs=None,
             num_parallel_tree=None, random_state=None, ...)
```

Prediction the test data

In [440…
```
test_data_prediction = model.predict(X_test)
```

In [441…
```
print(test_data_prediction)
```

```
[125.93621  221.98837   40.1335   ...  55.216927  66.620316 180.15579 ]
```

Mean Absolute error

In [442…
```
mae = metrics.mean_absolute_error(Y_test ,test_data_prediction) # y_test is original values and test_data_prediction is
```

In [443…
```
print("Mean absolute error = ", mae) # mae should be low value
```
```
Mean absolute error =  1.3719980459610621
```

In [444…
```
# Calculate R-squared value
r_squared = r2_score(Y_test, test_data_prediction)
```

In [445…
```
print("R squred value = ",r_squared) # R squared value measures goodness of fit in the model. It should be greater than
```
```
R squred value =  0.9989969382373513
```

R-squared value of 99.89% suggests that the model is performing exceptionally well in explaining and predicting the calories burn based on the provided features.

Model Testing & Evaluation

The trained model is further evaluated using the testing data to ensure generalizability and robustness.

In [446…
```
# Loading the model
model = XGBRegressor()
```

In [447…
```
# training the model with X_test and Y_test
model.fit(X_test, Y_test)
```

Out[447]:
```
XGBRegressor
XGBRegressor(base_score=None, booster=None, callbacks=None,
             colsample_bylevel=None, colsample_bynode=None,
             colsample_bytree=None, device=None, early_stopping_rounds=None,
             enable_categorical=False, eval_metric=None, feature_types=None,
             gamma=None, grow_policy=None, importance_type=None,
             interaction_constraints=None, learning_rate=None, max_bin=None,
             max_cat_threshold=None, max_cat_to_onehot=None,
             max_delta_step=None, max_depth=None, max_leaves=None,
             min_child_weight=None, missing=nan, monotone_constraints=None,
             multi_strategy=None, n_estimators=None, n_jobs=None,
             num_parallel_tree=None, random_state=None, ...)
```

Prediction the train data

In [448…
```
test_data_prediction = model.predict(X_test)
```

In [449…
```
print(test_data_prediction)
```

```
[128.11559   223.82436    37.367653 ...  54.994503  69.21072  179.01341 ]
```

Mean Absolute error

In [450…
```
mae = metrics.mean_absolute_error(Y_test ,test_data_prediction) # y_test is original values and test dataprediction is p
```

In [451…
```
print("Mean absolute error = ", mae) # mae should be low value
```

```
Mean absolute error =  0.38787183662255603
```

In [452…
```
# Calculate R-squared value
r_squared = r2_score(Y_test, test_data_prediction)
```

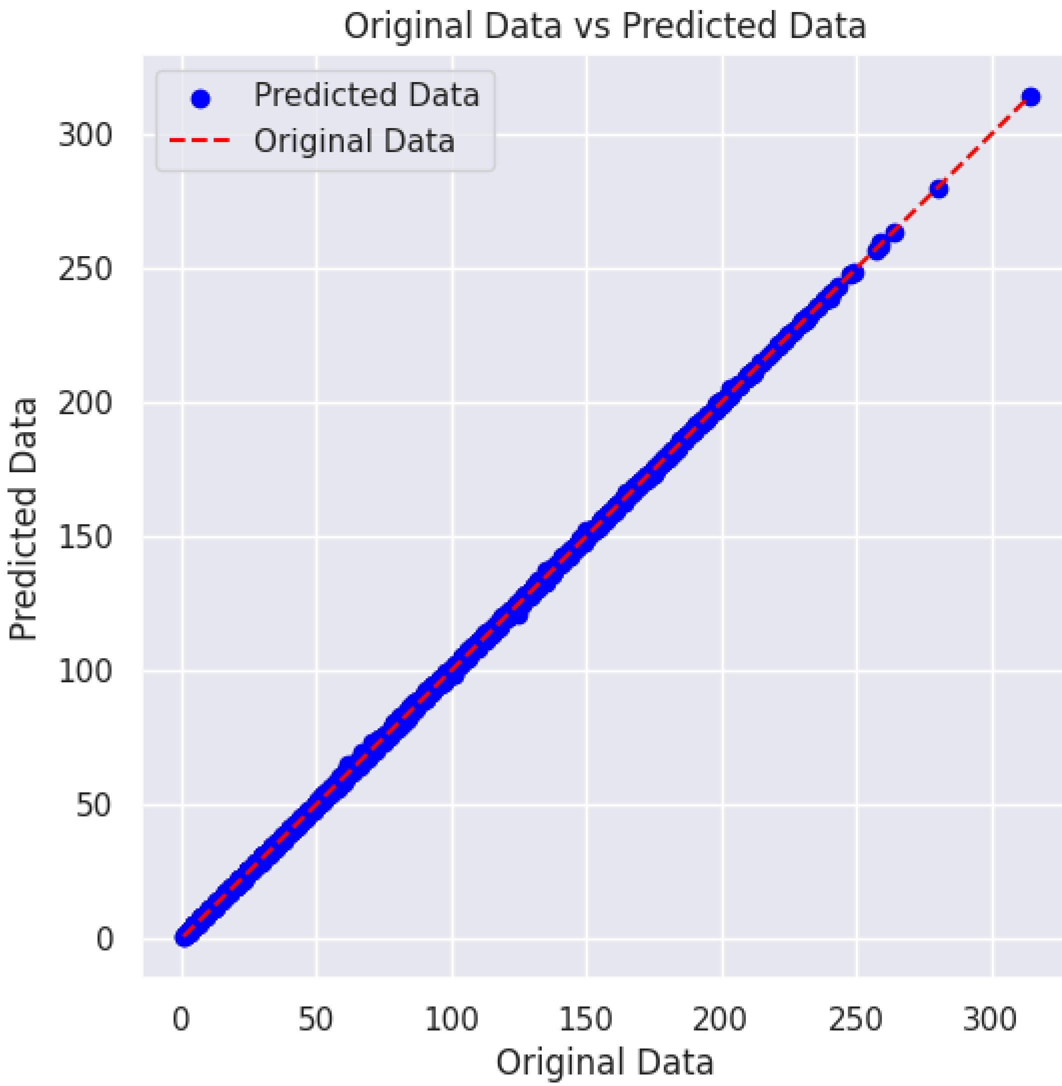
In [453…
```
print("R squred value = ",r_squared)
```

```
R squred value =  0.9999183765411656
```

R-squared value of 99.99% suggests that the model is performing exceptionally well in explaining and predicting the calories burn based on the provided features

In [454…
```
import matplotlib.pyplot as plt

# Plotting original data vs predicted data
plt.figure(figsize=(6, 6))
plt.scatter(Y_test, test_data_prediction, color='blue', label='Predicted Data')
plt.plot([min(Y_test), max(Y_test)], [min(Y_test), max(Y_test)], color='red', linestyle='--', label='Original Data')
plt.title('Original Data vs Predicted Data')
plt.xlabel('Original Data')
plt.ylabel('Predicted Data')
plt.legend()
plt.show()
```



Therefore according to the plot and the R squared value we can consider this trained model is accurate.