Identify data types and relevant variables using Python

Build dataframe

```
#Import relevant Python libraries and modules
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import datetime as dt
```

Data exploration

```
#Read CSV file
df = pd.read_csv('2025-10.csv', encoding='utf-8')
```

```
#Know the form of the DateFrame
df.shape
```

```
(1754353, 9)
```

```
#Find null or missing values
df.isna().sum()
```

```
Genero_Usuario           2
Edad_Usuario            82
Bici                     0
Ciclo_Estacion_Retiro    0
Fecha_Retiro             0
Hora_Retiro              0
Ciclo_EstacionArribo     0
Fecha_Arribo             0
Hora_Arribo              0
dtype: int64
```

```
#Erase null values
df = df.dropna()
```

```
#find duplicates
df.duplicated().sum()
```

```
np.int64(0)
```

```
#Validate changes
df.isna().sum()
```

```
Genero_Usuario          0
Edad_Usuario            0
Bici                    0
Ciclo_Estacion_Retiro   0
Fecha_Retiro            0
Hora_Retiro             0
Ciclo_EstacionArribo    0
Fecha_Arribo            0
Hora_Arribo             0
dtype: int64
```

```
#Convert columns to appropriate data types
df['Fecha_Retiro'] = pd.to_datetime(df['Fecha_Retiro'], format='%d/%m/%Y')
df['Fecha_Arribo'] = pd.to_datetime(df['Fecha_Arribo'], format='%d/%m/%Y')
```

```
#Create new columns for start and end datetime of the trip
df['Fecha_Hora_Inicio'] = pd.to_datetime(df['Fecha_Retiro'].astype(str) + ' ' +
df['Fecha_Hora_Fin'] = pd.to_datetime(df['Fecha_Arribo'].astype(str) + ' ' + df
```

```
#Create column for trip duration in minutes
df['Duracion_Viaje'] = (df['Fecha_Hora_Fin'] - df['Fecha_Hora_Inicio']).dt.tota
```

```
# Display and examine the first 5 rows of the dataframe
df.head(5)
```

	Genero_Usuario	Edad_Usuario	Bici	Ciclo_Estacion_Retiro	Fecha_Retiro	H
0	M	25.0	2250793	412	2025-09-30	
1	F	64.0	8309759	486	2025-09-30	
2	F	25.0	5941455	043	2025-09-30	
3	M	28.0	5233655	563	2025-09-30	
4	M	22.0	4988028	028	2025-09-30	

```
# Save cleaned DataFrame to a new CSV file
df.to_csv('df_cleaned_2025-10.csv', index=False, encoding='utf-8')
```

```
# Get summary statistics
df.describe()
```

	Edad_Usuario	Bici	Fecha_Retiro	Fecha_Arribo	Fecha_Hora_
count	1.754271e+06	1.754271e+06	1754271	1754271	1
mean	3.433349e+01	5.457177e+06	2025-10-16 12:26:14.980376832	2025-10-16 12:30:29.510720	202 02:53:19.493
min	1.600000e+01	2.000461e+06	2025-07-08 00:00:00	2025-10-01 00:00:00	2025-07-08 1
25%	2.700000e+01	3.732146e+06	2025-10-09 00:00:00	2025-10-09 00:00:00	202 11:05:32.
50%	3.200000e+01	5.452651e+06	2025-10-17 00:00:00	2025-10-17 00:00:00	2025-10-17 0
75%	3.900000e+01	7.195712e+06	2025-10-24 00:00:00	2025-10-24 00:00:00	202 17:58:46.

```
# Get summary info
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 1754271 entries, 0 to 1754352
Data columns (total 12 columns):
 #   Column                 Dtype
---  ------                 -----
 0   Genero_Usuario         object
 1   Edad_Usuario           float64
 2   Bici                   int64
 3   Ciclo_Estacion_Retiro  object
 4   Fecha_Retiro           datetime64[ns]
 5   Hora_Retiro            object
 6   Ciclo_EstacionArribo   object
 7   Fecha_Arribo           datetime64[ns]
 8   Hora_Arribo            object
 9   Fecha_Hora_Inicio      datetime64[ns]
 10  Fecha_Hora_Fin         datetime64[ns]
 11  Duracion_Viaje         float64
dtypes: datetime64[ns](4), float64(2), int64(1), object(5)
memory usage: 174.0+ MB
```

Understand the data - Investigate the variables

```
# Count occurrences of each age in 'Edad_Usuario'
df['Edad_Usuario'].value_counts()
```

```
Edad_Usuario
30.0     89377
29.0     86928
28.0     86844
32.0     85661
31.0     85387
         ...  
85.0         9
103.0        5
90.0         4
99.0         3
96.0         3
Name: count, Length: 76, dtype: int64
```

```
# Calculate average, minimum, and maximum user age
print(f"Average user age: {round(df['Edad_Usuario'].mean(), 1)}")
print(f"Minimum user age: {df['Edad_Usuario'].min()}")
print(f"Maximum user age: {df['Edad_Usuario'].max()}")
```

```
Average user age: 34.3
Minimum user age: 16.0
Maximum user age: 125.0
```

```
# Count occurrences of each gender in 'Genero_Usuario'
df['Genero_Usuario'].value_counts()
```

```
Genero_Usuario
M    1184038
F     486986
?      50651
O      32596
Name: count, dtype: int64
```

```
# Count occurrences of each day of the week in 'Fecha_Hora_Fin'
df['Fecha_Hora_Fin'].dt.day_name().value_counts()
```

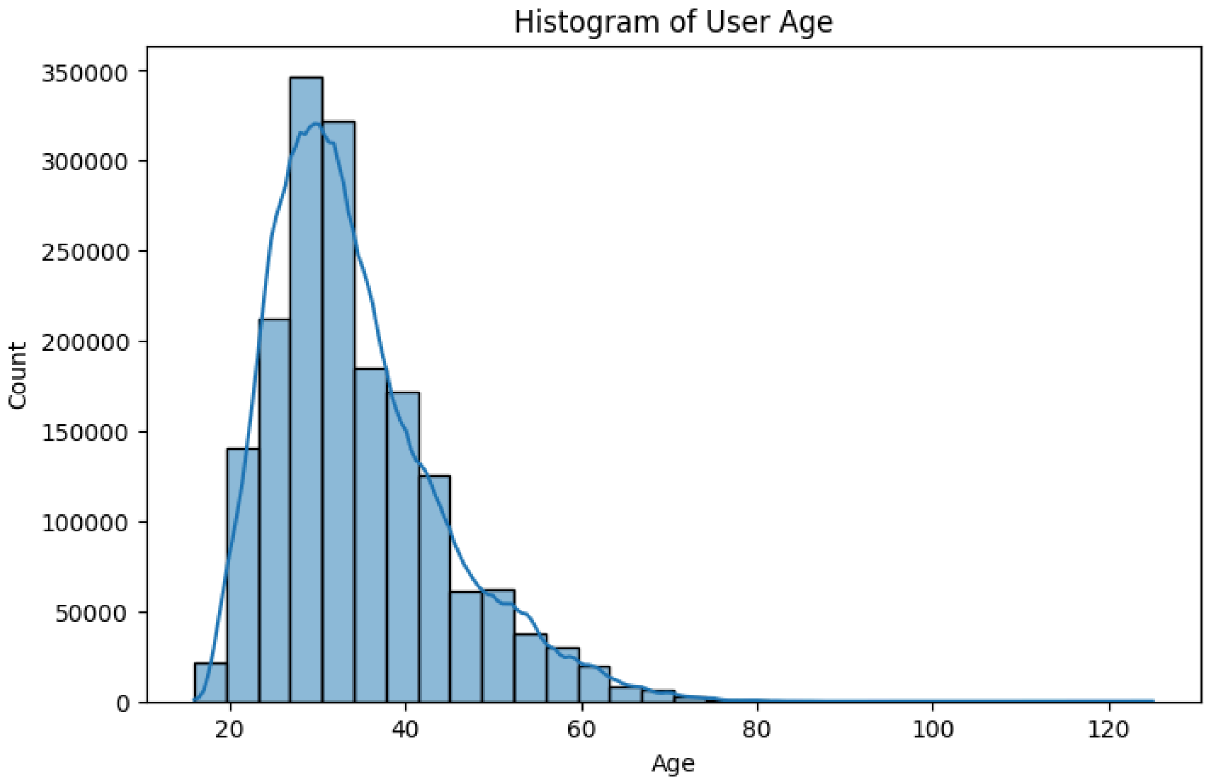
```
Fecha_Hora_Fin
Thursday     320983
Wednesday    307481
Friday       305090
Tuesday      276695
Monday       223984
Saturday     169687
Sunday       150351
Name: count, dtype: int64
```

```
# Calculate average, minimum, and maximum trip duration in minutes
print(f"Average trip duration: {round(df['Duracion_Viaje'].mean(), 1)}", 'minut
print(f"Minimum trip duration: {round(df['Duracion_Viaje'].min(), 1)}", 'minute
print(f"Maximum trip duration: {round(df['Duracion_Viaje'].max(), 1)}", 'minute
```

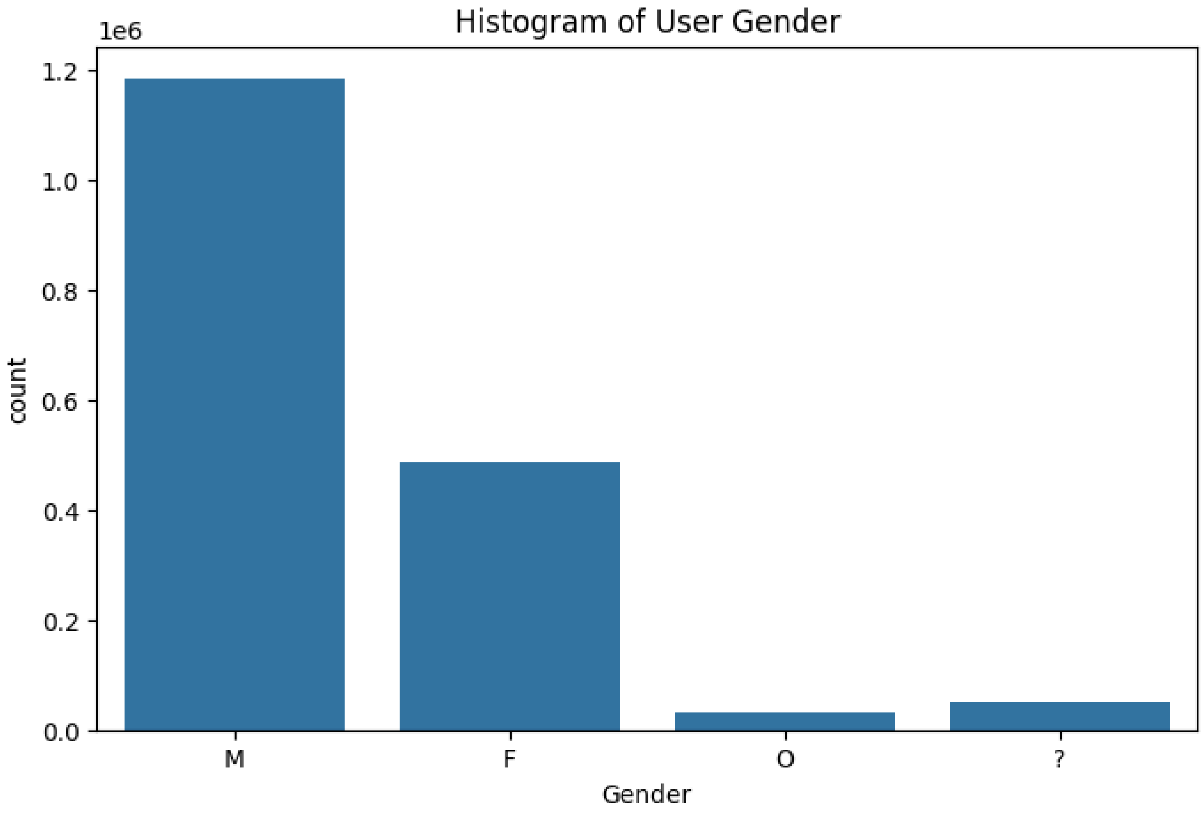
```
Average trip duration: 15.7 minutes
Minimum trip duration: 0.3 minutes
Maximum trip duration: 138558.8 minutes
```

Build Visualizations

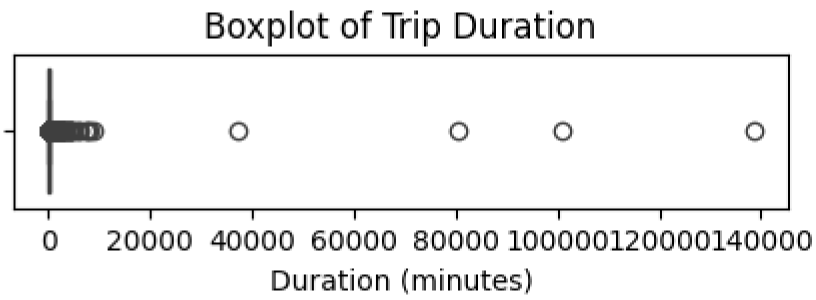
```
# Create a visualization of 'Edad_Usuario' distribution
plt.figure(figsize=(8,5))
sns.histplot(df['Edad_Usuario'], bins=30, kde=True)
plt.title('Histogram of User Age')
plt.xlabel('Age')
plt.show()
```



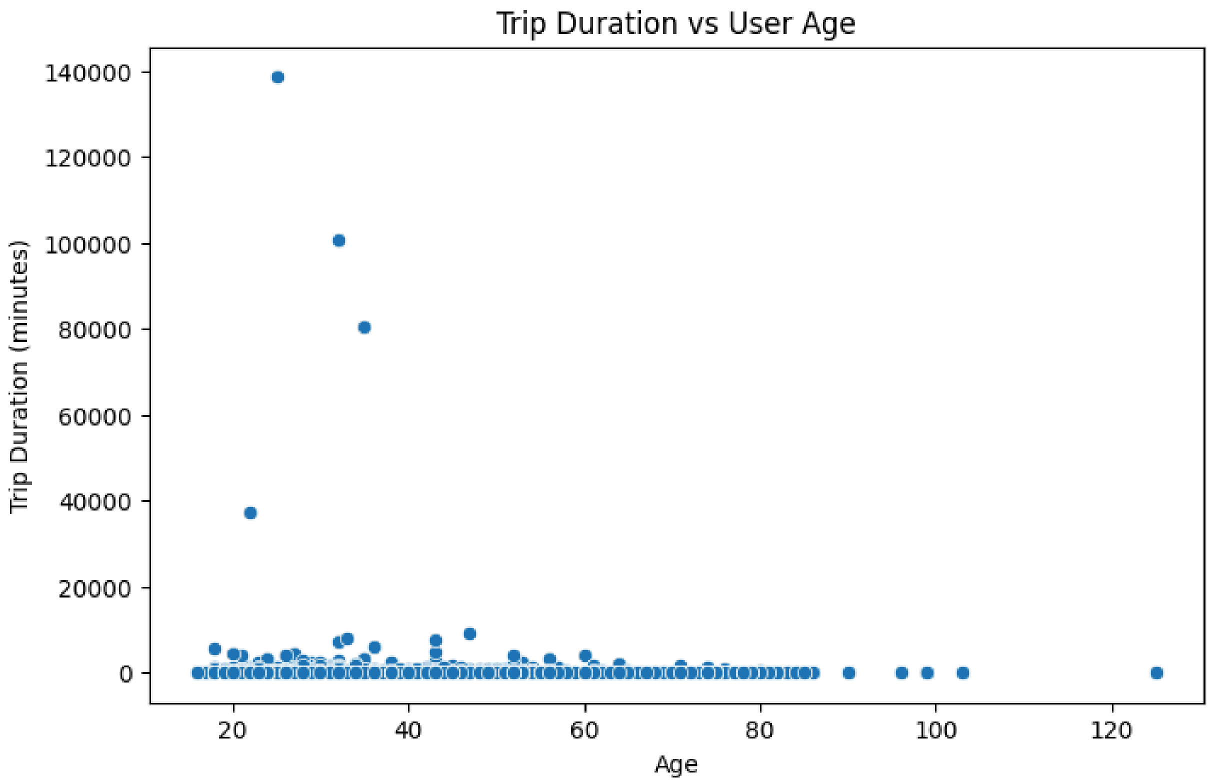
```
# Create a visualization of 'Genero_Usuario' distribution
plt.figure(figsize=(8,5))
sns.countplot(x=df['Genero_Usuario'])
plt.title('Histogram of User Gender')
plt.xlabel('Gender')
plt.show()
```



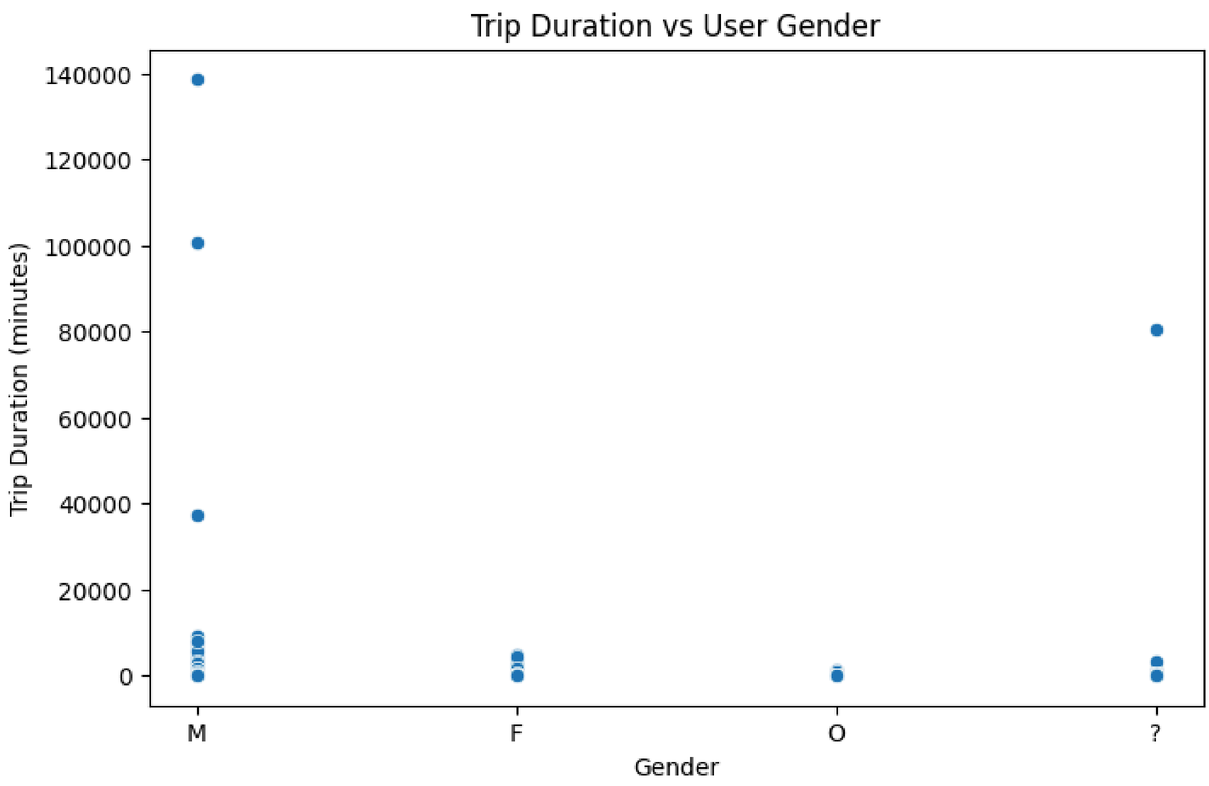
```
# Create a boxplot to visualize distribution of 'Duracion_Viaje'
plt.figure(figsize=(5,1))
sns.boxplot(x=df['Duracion_Viaje'])
plt.title('Boxplot of Trip Duration')
plt.xlabel('Duration (minutes)')
plt.show()
```



```
# Create a scatterplot of 'Duracion_Viaje' vs 'Edad_Usuario'
plt.figure(figsize=(8,5))
sns.scatterplot(x=df['Edad_Usuario'], y=df['Duracion_Viaje'])
plt.title('Trip Duration vs User Age')
plt.xlabel('Age')
plt.ylabel('Trip Duration (minutes)')
plt.show()
```



```
# Create a scatterplot of 'Genero_Usuario' vs 'Duracion_Viaje'
plt.figure(figsize=(8,5))
sns.scatterplot(x=df['Genero_Usuario'], y=df['Duracion_Viaje'])
plt.title('Trip Duration vs User Gender')
plt.xlabel('Gender')
plt.ylabel('Trip Duration (minutes)')
plt.show()
```



Hypothesis testing

```
# Import packages for statistical analysis/hypothesis testing
from scipy import stats
```

HO Null Hypothesis: There is no significant difference in trip durations based on user gender HA Alternative Hypothesis: There is a significant difference in trip durations based on user gender

```
# Create a Hypothesis test to compare trip durations
male = df[df['Genero_Usuario'] == 'M']['Duracion_Viaje']
female = df[df['Genero_Usuario'] == 'F']['Duracion_Viaje']
t_stat, p_value = stats.ttest_ind(male, female)
print(f"T-statistic: {t_stat}, P-value: {p_value}")
```

```
T-statistic: -1.942199286000038, P-value: 0.052113147306554794
```

```
# Interpretation
alpha = 0.05
```

```
if p_value < alpha:
    print("❌ We reject H₀: there is a significant difference in trip duration
else:
    print("✅ H₀ is not rejected: there is not enough evidence to conclude tha
```

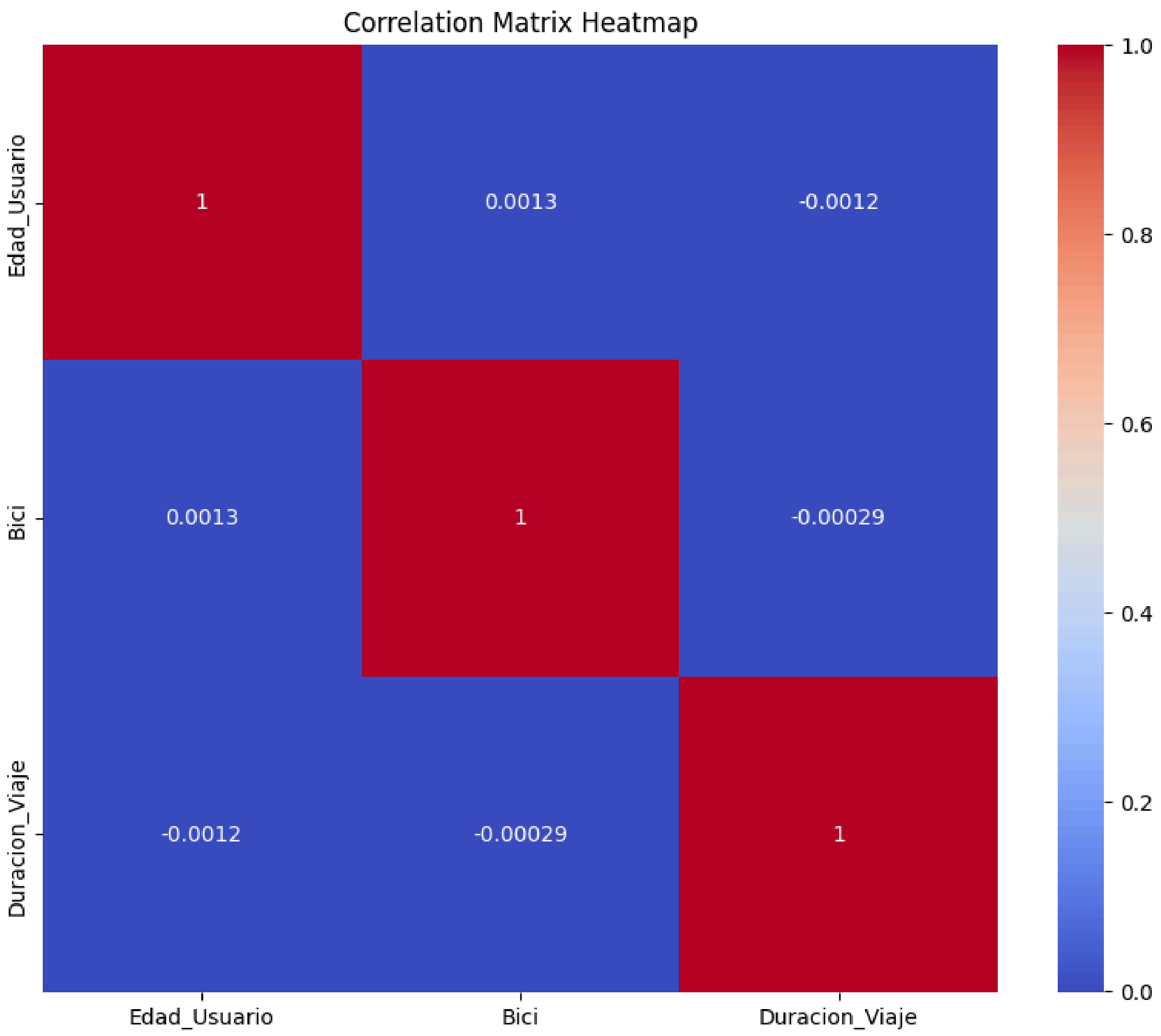
```
✅ H₀ is not rejected: there is not enough evidence to conclude that the trip d
```

Examine correlations

```
# Code a correlation matrix to help determine most correlated variables
df.corr(numeric_only=True)
```

	Edad_Usuario	Bici	Duracion_Viaje
Edad_Usuario	1.000000	0.001282	-0.001228
Bici	0.001282	1.000000	-0.000290
Duracion_Viaje	-0.001228	-0.000290	1.000000

```
# Create a heatmap to visualize how correlated variables are
plt.figure(figsize=(10,8))
sns.heatmap(df.corr(numeric_only=True), annot=True, cmap='coolwarm')
plt.title('Correlation Matrix Heatmap')
plt.show()
```



Experiment Regression

```
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.preprocessing import OneHotEncoder
from sklearn.metrics import mean_absolute_error, r2_score

# 1. Selección de variables
X = df[['Edad_Usuario', 'Genero_Usuario']]
y = df['Duracion_Viaje']
```

```
# 2. Codificación de variable categórica
encoder = OneHotEncoder(drop='first', sparse_output=False)
X_encoded = encoder.fit_transform(X[['Genero_Usuario']])
X_encoded_df = pd.DataFrame(X_encoded, columns=encoder.get_feature_names_out())

# 3. Concatenar con Edad_Usuario
X_final = pd.concat([X[['Edad_Usuario']].reset_index(drop=True), X_encoded_df],

# 4. División de datos
X_train, X_test, y_train, y_test = train_test_split(X_final, y, test_size=0.2,

# 5. Modelo de regresión
reg_model = LinearRegression()
reg_model.fit(X_train, y_train)

# 6. Evaluación
y_pred = reg_model.predict(X_test)
print("MAE:", mean_absolute_error(y_test, y_pred))
print("R²:", r2_score(y_test, y_pred))
```

```
MAE: 8.735489559831741
R²: 8.968444591528346e-05
```

Experiment Clasification

```
from sklearn.linear_model import LogisticRegression
from sklearn.preprocessing import LabelEncoder
from sklearn.metrics import classification_report

# 1. Selección de variables
X = df[['Duracion_Viaje', 'Edad_Usuario']]
y = df['Genero_Usuario']

# 2. Codificación de variable objetivo
label_encoder = LabelEncoder()
y_encoded = label_encoder.fit_transform(y)

# 3. División de datos
X_train, X_test, y_train, y_test = train_test_split(X, y_encoded, test_size=0.2

# 4. Modelo de clasificación
clf_model = LogisticRegression(max_iter=800)
clf_model.fit(X_train, y_train)

# 5. Evaluación
y_pred = clf_model.predict(X_test)
```

```
    print(classification report(y test, y pred, target names=label encoder.classes
```