```
# IMPORTANT: SOME KAGGLE DATA SOURCES ARE PRIVATE
# RUN THIS CELL IN ORDER TO IMPORT YOUR KAGGLE DATA SOURCES.
import kagglehub
kagglehub.login()
```

```
# IMPORTANT: RUN THIS CELL IN ORDER TO IMPORT YOUR KAGGLE DATA SOURCES,
# THEN FEEL FREE TO DELETE THIS CELL.
# NOTE: THIS NOTEBOOK ENVIRONMENT DIFFERS FROM KAGGLE'S PYTHON
# ENVIRONMENT SO THERE MAY BE MISSING LIBRARIES USED BY YOUR
# NOTEBOOK.

kagglesvij24_bank_01_path = kagglehub.dataset_download('kagglesvij24/bank-01')
kagglesvij24_bank_full_version1_path = kagglehub.dataset_download('kagglesvij24/bank-full-version1')
kagglesvij24__sav_scikitlearn_default_1_path = kagglehub.model_download('kagglesvij24/.sav/ScikitLearn/default/1')

print('Data source import complete.')
```

```
# This Python 3 environment comes with many helpful analytics libraries installed
# It is defined by the kaggle/python Docker image: https://github.com/kaggle/docker-python
# For example, here's several helpful packages to load

import numpy as np # linear algebra
import pandas as pd # data processing, CSV file I/O (e.g. pd.read_csv)

# Input data files are available in the read-only "../input/" directory
# For example, running this (by clicking run or pressing Shift+Enter) will list all files under the input directory

import os
for dirname, _, filenames in os.walk('/kaggle/input'):
    for filename in filenames:
        print(os.path.join(dirname, filename))

# You can write up to 20GB to the current directory (/kaggle/working/) that gets preserved as output when you create a version using "Save & Run All"
# You can also write temporary files to /kaggle/temp/, but they won't be saved outside of the current session
```

```
/kaggle/input/bank-full-version1/bank-full.csv
/kaggle/input/bank-01/bank.csv
/kaggle/input/.sav/scikitlearn/default/1/final_model.sav
```

Bank Marketing Campaign- Analysis and Model Deployment

Data Pre-Processing

Steps of preprocessing of data

- Import necessary library
- Read Dataset
- sanity check of dataStep
- Exploratory Data Analysis (EDA)
- Missing Value findings
- Outliers findings
- Duplicate Findings
- Normalization
- Encoding of Data

Exploratory Data Analysis

- **Using Pandas for basic statistics,summary, and descriptive analysis.**
- **Create histograms,boxplots,scatter plots, and other visualization to understand data distribution and relationships.**
- **Identify outliers and anomalies that migth affect analysis.**

Importing Necessary Libraries

Importing Necessary Libraries

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

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

Reading Dataset

```
Bank_data = pd.read_csv("/kaggle/input/bank-full-version1/bank-full.csv")
```

```
import pandas as pd


Bank_data = pd.read_csv('/kaggle/input/bank-full-version1/bank-full.csv')

# Display column names
print(Bank_data.columns)
```

```
Index(['sl. no', 'age', 'job', 'marital', 'education', 'default', 'balance',
       'housing', 'loan', 'contact', 'day', 'month', 'duration', 'campaign',
       'pdays', 'previous', 'poutcome', 'y'],
      dtype='object')
```

```
Bank_data.head()
```

	sl. no	age	job	marital	education	default	balance	housing	loan	contact	day	month	duration	campaign	pdays	previous	poutcome	y
0	1	58	management	married	tertiary	no	2143	yes	no	unknown	5	may	261	1	-1	0	unknown	no
1	2	44	technician	single	secondary	no	29	yes	no	unknown	5	may	151	1	-1	0	unknown	no
2	3	33	entrepreneur	married	secondary	no	2	yes	yes	unknown	5	may	76	1	-1	0	unknown	no
3	4	47	blue-collar	married	unknown	no	1506	yes	no	unknown	5	may	92	1	-1	0	unknown	no
4	5	33	unknown	single	unknown	no	1	no	no	unknown	5	may	198	1	-1	0	unknown	no

```
Bank_data
```

	sl. no	age	job	marital	education	default	balance	housing	loan	contact	day	month	duration	campaign	pdays	previous	poutcome	y
0	1	58	management	married	tertiary	no	2143	yes	no	unknown	5	may	261	1	-1	0	unknown	no
1	2	44	technician	single	secondary	no	29	yes	no	unknown	5	may	151	1	-1	0	unknown	no
2	3	33	entrepreneur	married	secondary	no	2	yes	yes	unknown	5	may	76	1	-1	0	unknown	no
3	4	47	blue-collar	married	unknown	no	1506	yes	no	unknown	5	may	92	1	-1	0	unknown	no
4	5	33	unknown	single	unknown	no	1	no	no	unknown	5	may	198	1	-1	0	unknown	no
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
45206	45207	51	technician	married	tertiary	no	825	no	no	cellular	17	nov	977	3	-1	0	unknown	yes
45207	45208	71	retired	divorced	primary	no	1729	no	no	cellular	17	nov	456	2	-1	0	unknown	yes
45208	45209	72	retired	married	secondary	no	5715	no	no	cellular	17	nov	1127	5	184	3	success	yes
45209	45210	57	blue-collar	married	secondary	no	668	no	no	telephone	17	nov	508	4	-1	0	unknown	no
45210	45211	37	entrepreneur	married	secondary	no	2971	no	no	cellular	17	nov	361	2	188	11	other	no

45211 rows × 18 columns

```
Bank_data.isna().sum()
```

```
sl. no       0
age          0
job          0
marital      0
education    0
default      0
balance      0
housing      0
loan         0
contact      0
day          0
month        0
duration     0
campaign     0
pdays        0
previous     0
poutcome     0
y            0
dtype: int64
```

Sanity Check

```
Bank_data.shape
```

```
(45211, 18)
```

```
Bank_data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 45211 entries, 0 to 45210
Data columns (total 18 columns):
 #   Column     Non-Null Count  Dtype 
---  ------     --------------  ----- 
 0   sl. no     45211 non-null  int64 
 1   age        45211 non-null  int64 
 2   job        45211 non-null  object
 3   marital    45211 non-null  object
 4   education  45211 non-null  object
 5   default    45211 non-null  object
 6   balance    45211 non-null  int64 
 7   housing    45211 non-null  object
 8   loan       45211 non-null  object
 9   contact    45211 non-null  object
 10  day        45211 non-null  int64 
 11  month      45211 non-null  object
 12  duration   45211 non-null  int64 
 13  campaign   45211 non-null  int64 
 14  pdays      45211 non-null  int64 
 15  previous   45211 non-null  int64 
 16  poutcome   45211 non-null  object
 17  y          45211 non-null  object
dtypes: int64(8), object(10)
memory usage: 6.2+ MB
```

Data Cleaning

Handle Duplicates

Remove duplicates

```
Bank_data = Bank_data.drop_duplicates()
Bank_data
```

	sl. no	age	job	marital	education	default	balance	housing	loan	contact	day	month	duration	campaign	pdays	previous	poutcome	y
0	1	58	management	married	tertiary	no	2143	yes	no	unknown	5	may	261	1	-1	0	unknown	no
1	2	44	technician	single	secondary	no	29	yes	no	unknown	5	may	151	1	-1	0	unknown	no
2	3	33	entrepreneur	married	secondary	no	2	yes	yes	unknown	5	may	76	1	-1	0	unknown	no
3	4	47	blue-collar	married	unknown	no	1506	yes	no	unknown	5	may	92	1	-1	0	unknown	no
4	5	33	unknown	single	unknown	no	1	no	no	unknown	5	may	198	1	-1	0	unknown	no
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
45206	45207	51	technician	married	tertiary	no	825	no	no	cellular	17	nov	977	3	-1	0	unknown	yes
45207	45208	71	retired	divorced	primary	no	1729	no	no	cellular	17	nov	456	2	-1	0	unknown	yes
45208	45209	72	retired	married	secondary	no	5715	no	no	cellular	17	nov	1127	5	184	3	success	yes
45209	45210	57	blue-collar	married	secondary	no	668	no	no	telephone	17	nov	508	4	-1	0	unknown	no
45210	45211	37	entrepreneur	married	secondary	no	2971	no	no	cellular	17	nov	361	2	188	11	other	no

45211 rows × 18 columns

Handle missing values

```
# Check for missing values
print(Bank_data.isnull().sum())
```

```
sl. no       0
age          0
job          0
marital      0
education    0
default      0
balance      0
housing      0
loan         0
contact      0
```

```
day         0
month       0
duration    0
campaign    0
pdays       0
previous    0
poutcome    0
y           0
dtype: int64
```

```
# Identifying garbage values
for i in Bank_data.select_dtypes(include='object').columns:
    print(Bank_data[i].value_counts())
    print("***" * 10)
```

```
job
blue-collar      9732
management       9458
technician       7597
admin.           5171
services         4154
retired          2264
self-employed    1579
entrepreneur     1487
unemployed       1303
housemaid        1240
student           938
unknown           288
Name: count, dtype: int64
******************************
marital
married     27214
single      12790
divorced     5207
Name: count, dtype: int64
******************************
education
secondary    23202
tertiary     13301
primary       6851
unknown       1857
Name: count, dtype: int64
******************************
default
no     44396
yes      815
Name: count, dtype: int64
******************************
housing
yes    25130
no     20081
Name: count, dtype: int64
******************************
loan
no     37967
yes     7244
Name: count, dtype: int64
******************************
contact
cellular     29285
unknown      13020
telephone     2906
Name: count, dtype: int64
******************************
month
may    13766
jul     6895
aug     6247
jun     5341
nov     3970
apr     2932
feb     2649
jan     1403
```

```
# Finding Missing values percentage
missing_percentage = (Bank_data.isnull().sum() / len(Bank_data)) * 100
print(missing_percentage)
```

```
sl. no       0.0
age          0.0
job          0.0
marital      0.0
education    0.0
default      0.0
balance      0.0
housing      0.0
loan         0.0
contact      0.0
day          0.0
month        0.0
duration     0.0
campaign     0.0
pdays        0.0
previous     0.0
poutcome     0.0
y            0.0
dtype: float64
```

```
Bank_data.isna().sum()
```

```
sl. no       0
age          0
job          0
marital      0
education    0
default      0
balance      0
housing      0
loan         0
contact      0
day          0
month        0
duration     0
campaign     0
pdays        0
previous     0
poutcome     0
y            0
dtype: int64
```

Exploratory Data Analysis (EDA)

```
# importing the external libraries
import pandas as pd

# importing the data
Bank_data=pd.read_csv("/kaggle/input/bank-full-version1/bank-full.csv")
```

Descriptive Statistics of the Numerical Column

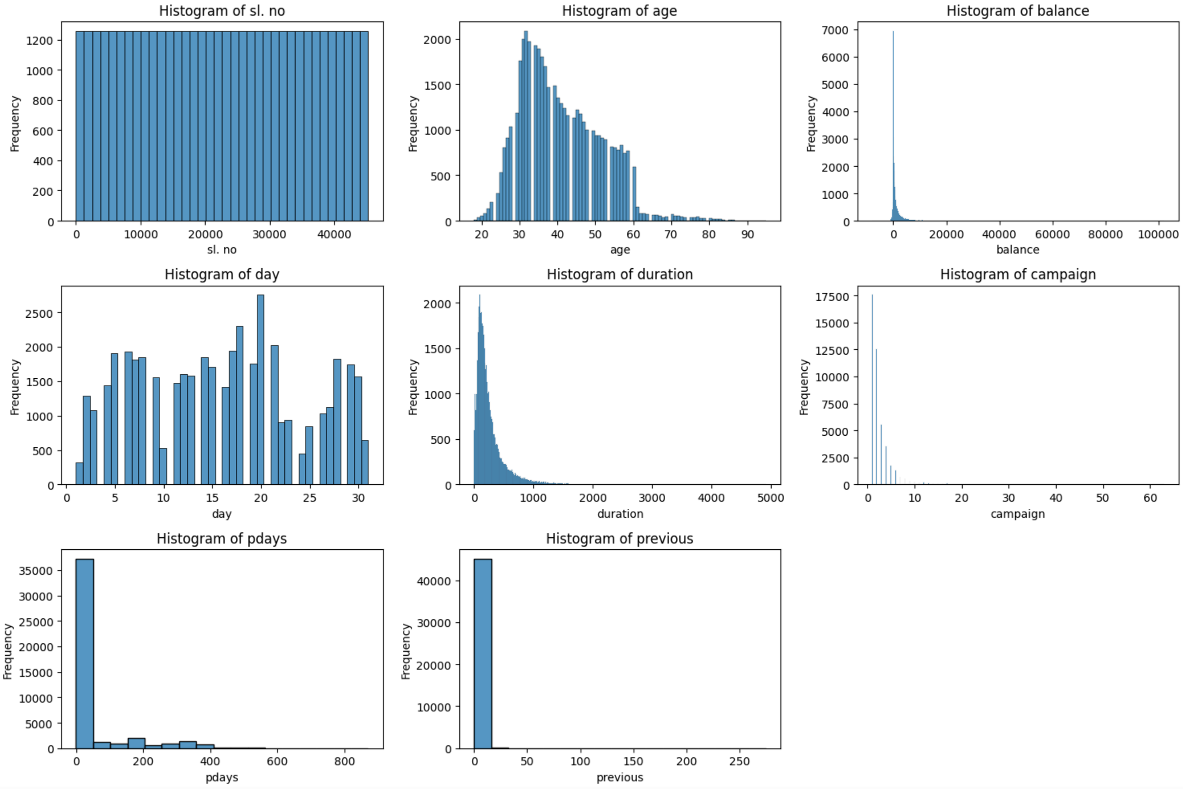
```
Bank_data.describe()
```

	sl. no	age	balance	day	duration	campaign	pdays	previous
count	45211.000000	45211.000000	45211.000000	45211.000000	45211.000000	45211.000000	45211.000000	45211.000000
mean	22606.000000	40.936210	1362.272058	15.806419	258.163080	2.763841	40.197828	0.580323
std	13051.435847	10.618762	3044.765829	8.322476	257.527812	3.098021	100.128746	2.303441
min	1.000000	18.000000	-8019.000000	1.000000	0.000000	1.000000	-1.000000	0.000000
25%	11303.500000	33.000000	72.000000	8.000000	103.000000	1.000000	-1.000000	0.000000
50%	22606.000000	39.000000	448.000000	16.000000	180.000000	2.000000	-1.000000	0.000000
75%	33908.500000	48.000000	1428.000000	21.000000	319.000000	3.000000	-1.000000	0.000000
max	45211.000000	95.000000	102127.000000	31.000000	4918.000000	63.000000	871.000000	275.000000

Descriptive Statistics of the object column

Bank_data.describe(include='object')

```
import warnings
import seaborn as sns
import matplotlib.pyplot as plt

warnings.filterwarnings("ignore")

# Select numerical columns
numeric_columns = Bank_data.select_dtypes(include="number").columns

# Create subplots
num_plots = len(numeric_columns)
num_cols = 3  # Number of columns in the subplot grid
num_rows = (num_plots // num_cols) + (num_plots % num_cols > 0)

fig, axes = plt.subplots(num_rows, num_cols, figsize=(15, 10))

# Flatten axes array for easy iteration
axes = axes.flatten()

# Plotting each numerical column in a separate subplot
for i, col in enumerate(numeric_columns):
    sns.histplot(data=Bank_data, x=col, ax=axes[i])
    axes[i].set_title(f'Histogram of {col}')
    axes[i].set_xlabel(col)
    axes[i].set_ylabel('Frequency')

# Remove empty subplots if there are any
for j in range(i + 1, len(axes)):
    fig.delaxes(axes[j])

plt.tight_layout()
plt.show()
```

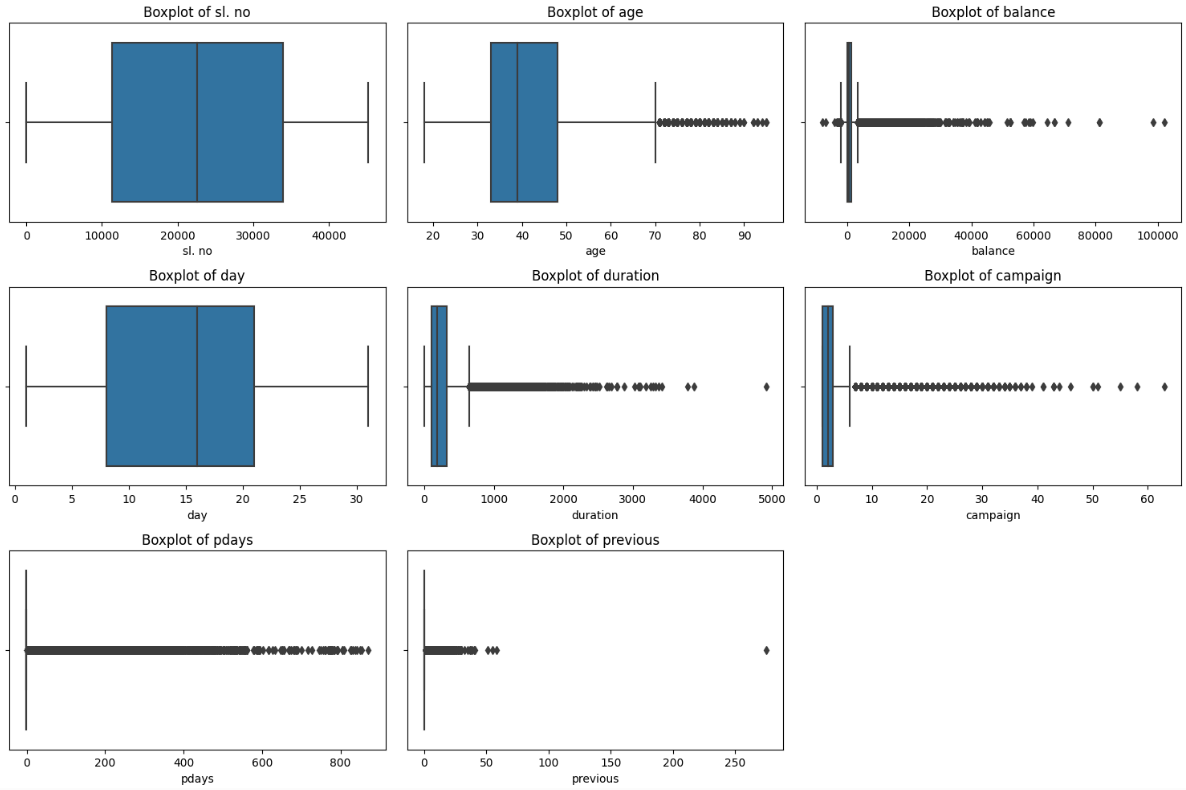


```
# histogram to understand the distribution
import warnings
warnings.filterwarnings("ignore")
for i in Bank_data.select_dtypes(include="number").columns:
    sns.histplot(data=Bank_data,x=i)
    plt.show()
```

Show hidden output

```
import warnings
import seaborn as sns
import matplotlib.pyplot as plt

warnings.filterwarnings("ignore")

# Select numerical columns
numeric_columns = Bank_data.select_dtypes(include="number").columns

# Create subplots
num_plots = len(numeric_columns)
num_cols = 3  # Number of columns in the subplot grid
num_rows = (num_plots // num_cols) + (num_plots % num_cols > 0)

fig, axes = plt.subplots(num_rows, num_cols, figsize=(15, 10))
```

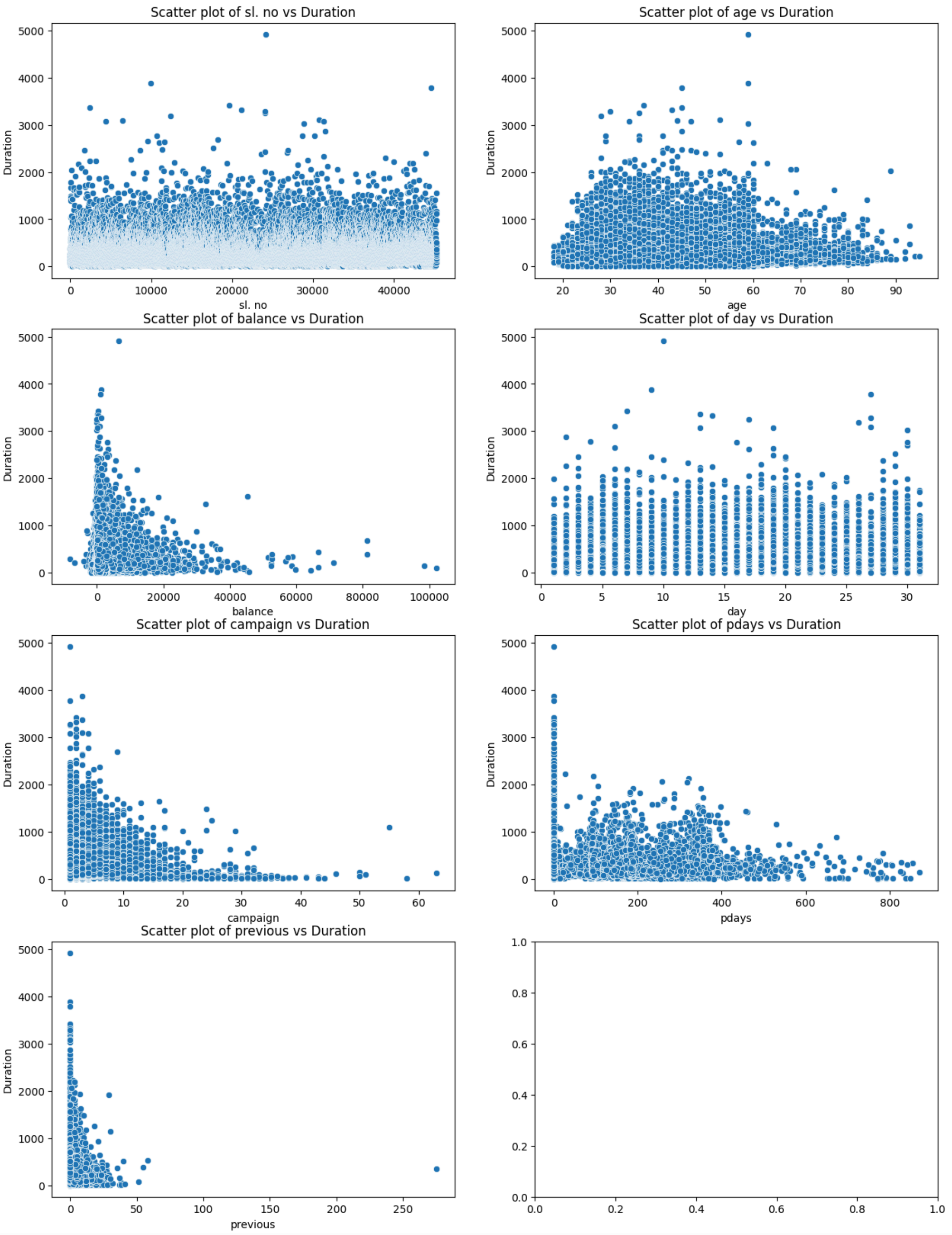
```
# Flatten axes array for easy iteration
axes = axes.flatten()

# Plotting each numerical column in a separate subplot
for i, col in enumerate(numeric_columns):
    sns.boxplot(data=Bank_data, x=col, ax=axes[i])
    axes[i].set_title(f'Boxplot of {col}')
    axes[i].set_xlabel(col)
    axes[i].set_ylabel('')

# Remove empty subplots if there are any
for j in range(i + 1, len(axes)):
    fig.delaxes(axes[j])

plt.tight_layout()
plt.show()
```



```
#Identify Outliers
import warnings
warnings.filterwarnings("ignore")
for i in Bank_data.select_dtypes(include="number").columns:
    sns.boxplot(data=Bank_data,x=i)
    plt.show()
```

Show hidden output

```
import seaborn as sns
import matplotlib.pyplot as plt

# List of columns to plot
columns = ['sl. no', 'age', 'balance', 'day', 'campaign', 'pdays', 'previous']

# Number of rows and columns for subplots
num_cols = 2  # Number of columns in the subplot grid
num_rows = (len(columns) // num_cols) + (len(columns) % num_cols > 0)  # Calculate the number of rows

fig, axes = plt.subplots(num_rows, num_cols, figsize=(15, 20))

# Flatten axes array for easy iteration
axes = axes.flatten()

# Plotting each scatter plot in a separate subplot
for i, col in enumerate(columns):
    sns.scatterplot(data=Bank_data, x=col, y='duration', ax=axes[i])
    axes[i].set_title(f'Scatter plot of {col} vs Duration')
    axes[i].set_xlabel(col)
    axes[i].set_ylabel('Duration')

# Remove empty subplots if
```



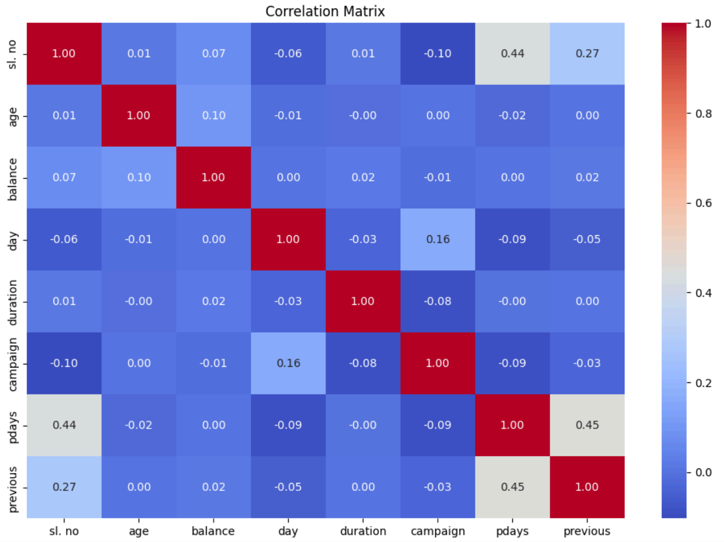
```
#scatterplot to understand the relationship
import seaborn as sns
import matplotlib.pyplot as plt

# List of columns to plot
columns = ['sl. no', 'age', 'balance', 'day', 'campaign', 'pdays', 'previous']

for i in columns:
    plt.figure(figsize=(10, 6))
    sns.scatterplot(data=Bank_data, x=i, y='duration')
    plt.title(f'Scatter plot of {i} vs Duration')
    plt.show()
```

Show hidden output

```
# correlation with heatmap to interpret the relation and multicolliniarity

# Select numerical columns
numerical_columns = Bank_data.select_dtypes(include='number').columns

# Compute the correlation matrix
correlation_matrix = Bank_data[numerical_columns].corr()

# Display the correlation matrix
print(correlation_matrix)
```

```
              sl. no       age   balance       day  duration  campaign  \
sl. no    1.000000  0.014973  0.073639 -0.061465  0.013031 -0.102884
age       0.014973  1.000000  0.097783 -0.009120 -0.004648  0.004760
balance   0.073639  0.097783  1.000000  0.004503  0.021560 -0.014578
day      -0.061465 -0.009120  0.004503  1.000000 -0.030206  0.162490
duration  0.013031 -0.004648  0.021560 -0.030206  1.000000 -0.084570
campaign -0.102884  0.004760 -0.014578  0.162490 -0.084570  1.000000
pdays     0.437729 -0.023758  0.003435 -0.093044 -0.001565 -0.088628
previous  0.271098  0.001288  0.016674 -0.051710  0.001203 -0.032855

             pdays  previous
sl. no    0.437729  0.271098
age      -0.023758  0.001288
balance   0.003435  0.016674
day      -0.093044 -0.051710
duration -0.001565  0.001203
campaign -0.088628 -0.032855
pdays     1.000000  0.454820
previous  0.454820  1.000000
```

```
# correlation with heatmap to interpret the relation and multicolliniarity
import seaborn as sns
import matplotlib.pyplot as plt

# Plot the correlation matrix using a heatmap
plt.figure(figsize=(12, 8))
sns.heatmap(correlation_matrix, annot=True, cmap='coolwarm', fmt=".2f")
plt.title('Correlation Matrix')
plt.show()
```



Missing value treatments

```
from sklearn.impute import SimpleImputer

# Create a SimpleImputer instance
imputer = SimpleImputer(strategy='most_frequent')

# Iterating through categorical columns and imputing missing values
for col in Bank_data.select_dtypes(include='object').columns:
    Bank_data[col] = imputer.fit_transform(Bank_data[[col]]).ravel()

print(Bank_data.head())  # Display the first few rows of the DataFrame to check the result
```

```
   sl. no  age           job  marital  education default  balance housing  \
0       1   58    management  married   tertiary      no     2143     yes
1       2   44    technician   single  secondary      no       29     yes
2       3   33  entrepreneur  married  secondary      no        2     yes
3       4   47   blue-collar  married    unknown      no     1506     yes
4       5   33       unknown   single    unknown      no        1      no

  loan  contact  day month  duration  campaign  pdays  previous poutcome   y
0   no  unknown    5   may       261         1     -1         0  unknown  no
1   no  unknown    5   may       151         1     -1         0  unknown  no
2  yes  unknown    5   may        76         1     -1         0  unknown  no
3   no  unknown    5   may        92         1     -1         0  unknown  no
4   no  unknown    5   may       198         1     -1         0  unknown  no
```

```
Bank_data.isnull().sum()
```

```
sl. no       0
age          0
job          0
marital      0
education    0
default      0
balance      0
housing      0
loan         0
contact      0
day          0
month        0
duration     0
campaign     0
pdays        0
previous     0
poutcome     0
y            0
dtype: int64
```

```
Bank_data.select_dtypes(include='number').columns
```

```
Index(['sl. no', 'age', 'balance', 'day', 'duration', 'campaign', 'pdays',
       'previous'],
      dtype='object')
```

```
new_bank_data = Bank_data.sort_values(by='balance', ascending=True)
```

```
print(Bank_data.columns)
```

```
Index(['sl. no', 'age', 'job', 'marital', 'education', 'default', 'balance',
       'housing', 'loan', 'contact', 'day', 'month', 'duration', 'campaign',
       'pdays', 'previous', 'poutcome', 'y'],
      dtype='object')
```

From Above EDA Numerical Columns are **'age'** and **'balance'**. Outliers are Considered for the columns

↳, 2 cells hidden

Outlier Detection and Handling

```
#Outlier Detection and Handling:
#Identify and remove outliers in the 'balance' column:
Q1 = new_bank_data['balance'].quantile(0.25)
Q3 = new_bank_data['balance'].quantile(0.75)
IQR= Q3-Q1

print(Q1)
print(Q3)
print(IQR)
```

Show hidden output

```
#Outlier Detection and Handling:
#Identify and remove outliers in the 'age' column:
Q1 = new_bank_data['age'].quantile(0.25)
Q3 = new_bank_data['age'].quantile(0.75)
IQR= Q3-Q1

print(Q1)
print(Q3)
print(IQR)
```

Show hidden output

```
import numpy as np

def whisker(col):
    q1, q3 = np.percentile(col, [25, 75])
    iqr = q3 - q1
    lw = q1 - 1.5 * iqr
    up = q3 + 1.5 * iqr
    return lw, up
```

```
lw, up = whisker(Bank_data['duration'])
print(f'Lower whisker: {lw}')
print(f'Upper whisker: {up}')
```

```
Lower whisker: -221.0
Upper whisker: 643.0
```

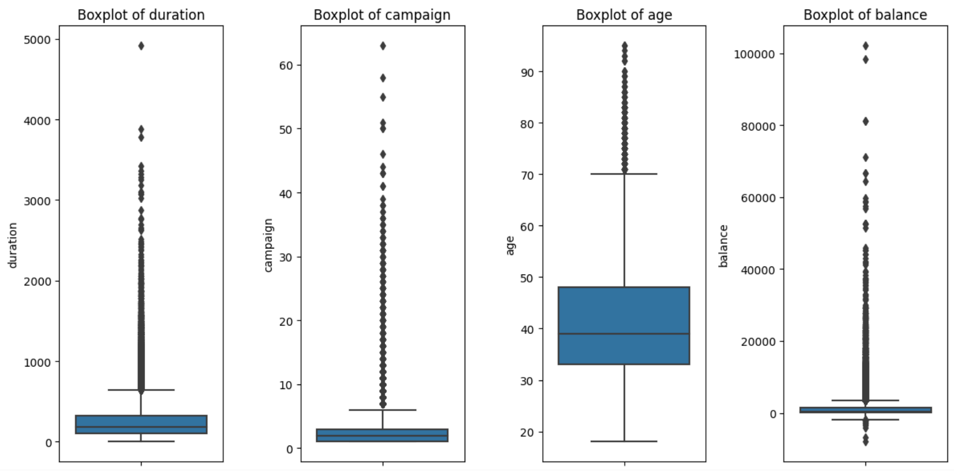
```
lw, up = whisker(Bank_data['campaign'])
print(f'Lower whisker: {lw}')
print(f'Upper whisker: {up}')
```

```
Lower whisker: -2.0
Upper whisker: 6.0
```

```
import numpy as np

# Define your DataFrame
df = Bank_data.copy()  # Make a copy of Bank_data to avoid modifying the original

# Define the whisker function if not already defined
def whisker(col):
    q1, q3 = np.percentile(col, [25, 75])
    iqr = q3 - q1
    lw = q1 - 1.5 * iqr
    up = q3 + 1.5 * iqr
    return lw, up

# Loop through the specified columns and apply the whisker limits
for i in ['duration', 'campaign']:
    lw, up = whisker(Bank_data[i])
    df[i] = np.where(Bank_data[i] < lw, lw, Bank_data[i])
    df[i] = np.where(Bank_data[i] > up, up, Bank_data[i])

print(df.head())
```

```
   sl. no  age           job  marital  education default  balance housing  \
0       1   58    management  married   tertiary      no     2143     yes   
1       2   44    technician   single  secondary      no       29     yes   
2       3   33  entrepreneur  married  secondary      no        2     yes   
3       4   47   blue-collar  married    unknown      no     1506     yes   
4       5   33       unknown   single    unknown      no        1      no   

  loan  contact  day month  duration  campaign  pdays  previous poutcome   y  
0   no  unknown    5   may     261.0       1.0     -1         0  unknown  no  
1   no  unknown    5   may     151.0       1.0     -1         0  unknown  no  
2  yes  unknown    5   may      76.0       1.0     -1         0  unknown  no  
3   no  unknown    5   may      92.0       1.0     -1         0  unknown  no  
4   no  unknown    5   may     198.0       1.0     -1         0  unknown  no  
```

```
import seaborn as sns
import matplotlib.pyplot as plt

# List of columns to create boxplots for
columns = ['duration', 'campaign', 'age', 'balance' ]

# Create boxplots
plt.figure(figsize=(12, 6))
for i, col in enumerate(columns, 1):
    plt.subplot(1, len(columns), i)
    sns.boxplot(y=Bank_data[col])
    plt.title(f'Boxplot of {col}')
    plt.tight_layout()

plt.show()
```



```
Bank_data
```

	sl. no	age	job	marital	education	default	balance	housing	loan	contact	day	month	duration	campaign	pdays	previous	poutcome	y
0	1	58	management	married	tertiary	no	2143	yes	no	unknown	5	may	261	1	-1	0	unknown	no
1	2	44	technician	single	secondary	no	29	yes	no	unknown	5	may	151	1	-1	0	unknown	no
2	3	33	entrepreneur	married	secondary	no	2	yes	yes	unknown	5	may	76	1	-1	0	unknown	no
3	4	47	blue-collar	married	unknown	no	1506	yes	no	unknown	5	may	92	1	-1	0	unknown	no
4	5	33	unknown	single	unknown	no	1	no	no	unknown	5	may	198	1	-1	0	unknown	no
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
45206	45207	51	technician	married	tertiary	no	825	no	no	cellular	17	nov	977	3	-1	0	unknown	yes
45207	45208	71	retired	divorced	primary	no	1729	no	no	cellular	17	nov	456	2	-1	0	unknown	yes
45208	45209	72	retired	married	secondary	no	5715	no	no	cellular	17	nov	1127	5	184	3	success	yes
45209	45210	57	blue-collar	married	secondary	no	668	no	no	telephone	17	nov	508	4	-1	0	unknown	no

Renaming column (Feature Selection)

```
Bank_data.rename(columns = {'y':'deposited?'}, inplace = True)
```

```
from sklearn.model_selection import train_test_split

# Prepare features and target
x = Bank_data.drop(['deposited?'], axis=1)
y =Bank_data['deposited?']

# Split the data into training and testing sets
x_train, x_test, y_train, y_test = train_test_split(x, y, test_size=0.3, random_state=42)

print(f'Training data shape: {x_train.shape}, {y_train.shape}')
print(f'Testing data shape: {x_test.shape}, {y_test.shape}')
```

```
Training data shape: (31647, 17), (31647,)
Testing data shape: (13564, 17), (13564,)
```

```
df_train = x_train.copy()
df_train['deposited?'] = y_train
df_train.head()
```

	sl. no	age	job	marital	education	default	balance	housing	loan	contact	day	month	duration	campaign	pdays	previous	poutcome	deposited?
10747	10748	36	technician	single	tertiary	no	0	no	no	unknown	17	jun	153	4	-1	0	unknown	no
26054	26055	56	entrepreneur	married	secondary	no	196	no	no	cellular	19	nov	312	3	-1	0	unknown	no
9125	9126	46	blue-collar	married	secondary	no	0	yes	no	unknown	5	jun	83	2	-1	0	unknown	no
41659	41660	41	management	divorced	tertiary	no	3426	no	no	cellular	1	oct	302	1	119	5	success	no
4443	4444	38	blue-collar	married	secondary	no	0	yes	no	unknown	20	may	90	1	-1	0	unknown	no

Encoding of Data -One Hot Encoding

```
x = pd.get_dummies(x)
x.columns=[x.lower() for x in x.columns]
x_train,x_test,y_train,y_test=train_test_split(x,y,random_state=42,test_size=0.3, stratify=y)
```

```
import pandas as pd
from sklearn.model_selection import train_test_split

x = pd.get_dummies(x)
x.columns = [col.lower() for col in x.columns]

x_train, x_test, y_train, y_test = train_test_split(x, y, random_state=42, test_size=0.3, stratify=y)
```

```
classes=df_train['deposited?'].value_counts()
normal_share=round(classes[0]/df_train['deposited?'].count()*100,2)
fraud_share=round(classes[1]/df_train['deposited?'].count()*100, 2)
print("Non-deposited? : {} %".format(normal_share))
print("deposited? : {} %".format(fraud_share))
```

```
Non-deposited? : 88.34 %
deposited? : 11.66 %
```

```
x_train=df_train.drop(['deposited?'],axis=1)
y_train=df_train['deposited?']
```

```
import pandas as pd

# Assuming `newdataframe` is your original DataFrame containing the 'deposited' column
x = pd.get_dummies(Bank_data.drop(['deposited?'], axis=1))
y = pd.get_dummies(Bank_data['deposited?'], drop_first=True)

# Convert all column names to lowercase
x.columns = [col.lower() for col in x.columns]
y.columns = ['deposited']  # Rename the target column for clarity

print(x.head())  # Display the first few rows of the feature matrix
print(y.head())  # Display the first few rows of the target variable
```

```
   sl. no  age  balance  day  duration  campaign  pdays  previous  job_admin.  \
0       1   58     2143    5       261         1     -1         0       False
1       2   44       29    5       151         1     -1         0       False
2       3   33        2    5        76         1     -1         0       False
3       4   47     1506    5        92         1     -1         0       False
4       5   33        1    5       198         1     -1         0       False

   job_blue-collar  ...  month_jun  month_mar  month_may  month_nov  \
0            False  ...      False      False       True      False
1            False  ...      False      False       True      False
2            False  ...      False      False       True      False
3             True  ...      False      False       True      False
4            False  ...      False      False       True      False

   month_oct  month_sep  poutcome_failure  poutcome_other  poutcome_success  \
```