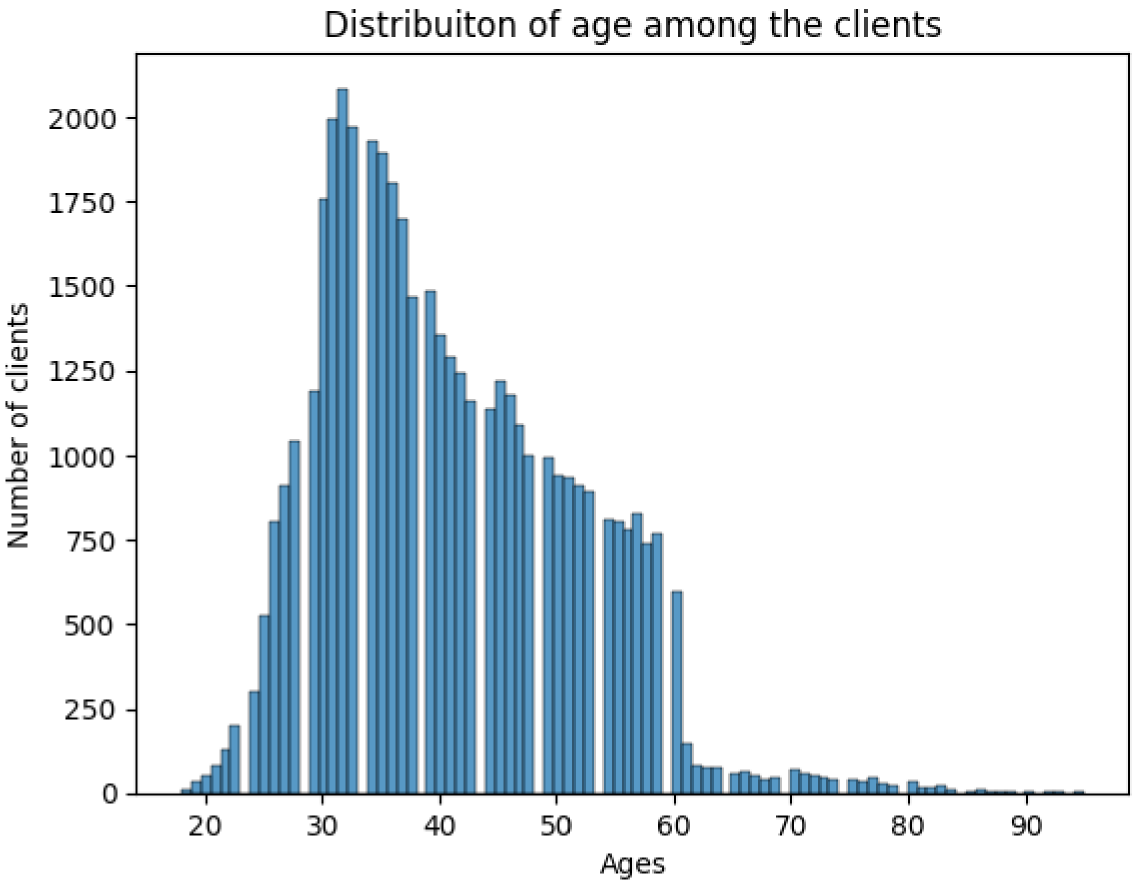
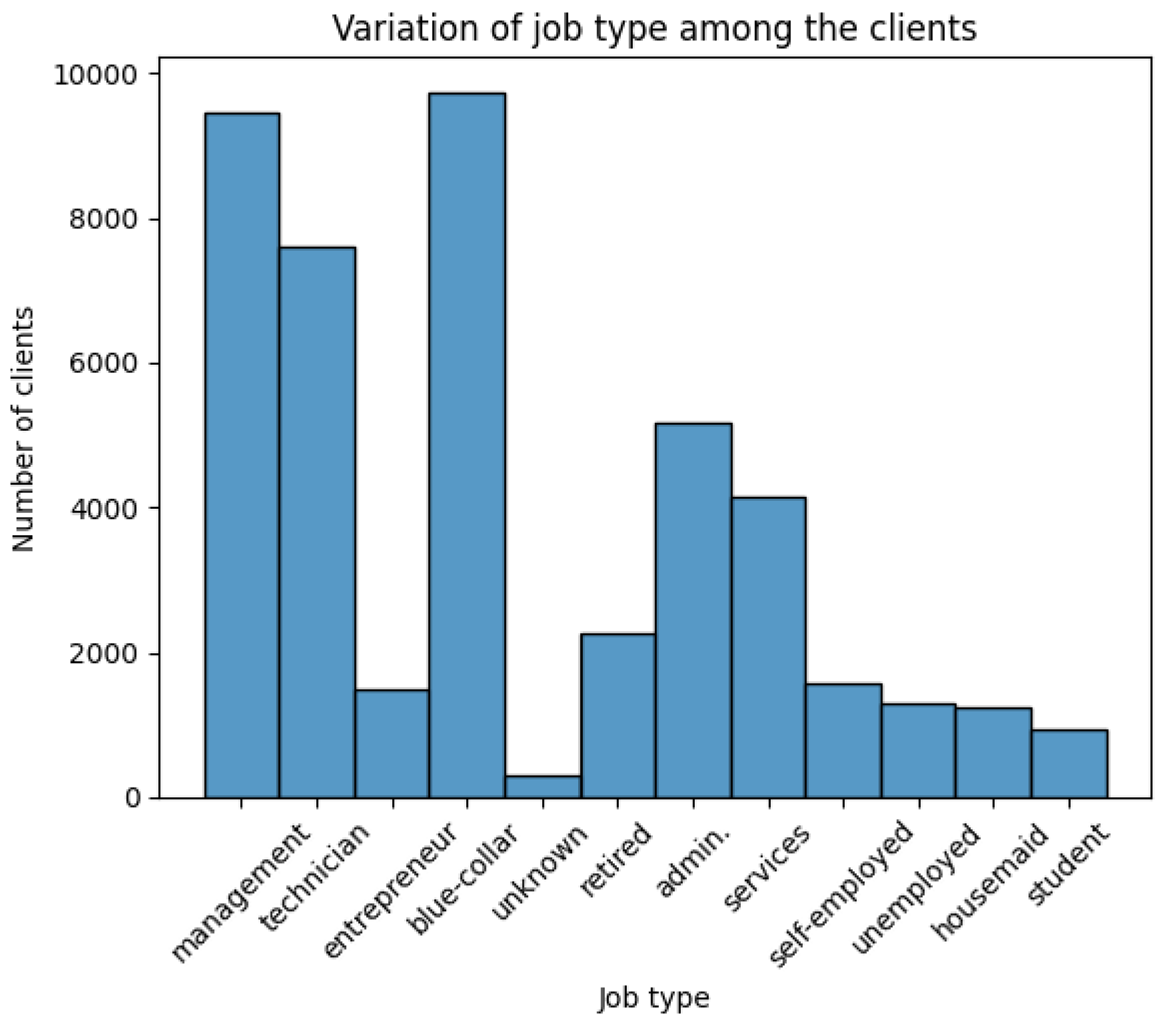
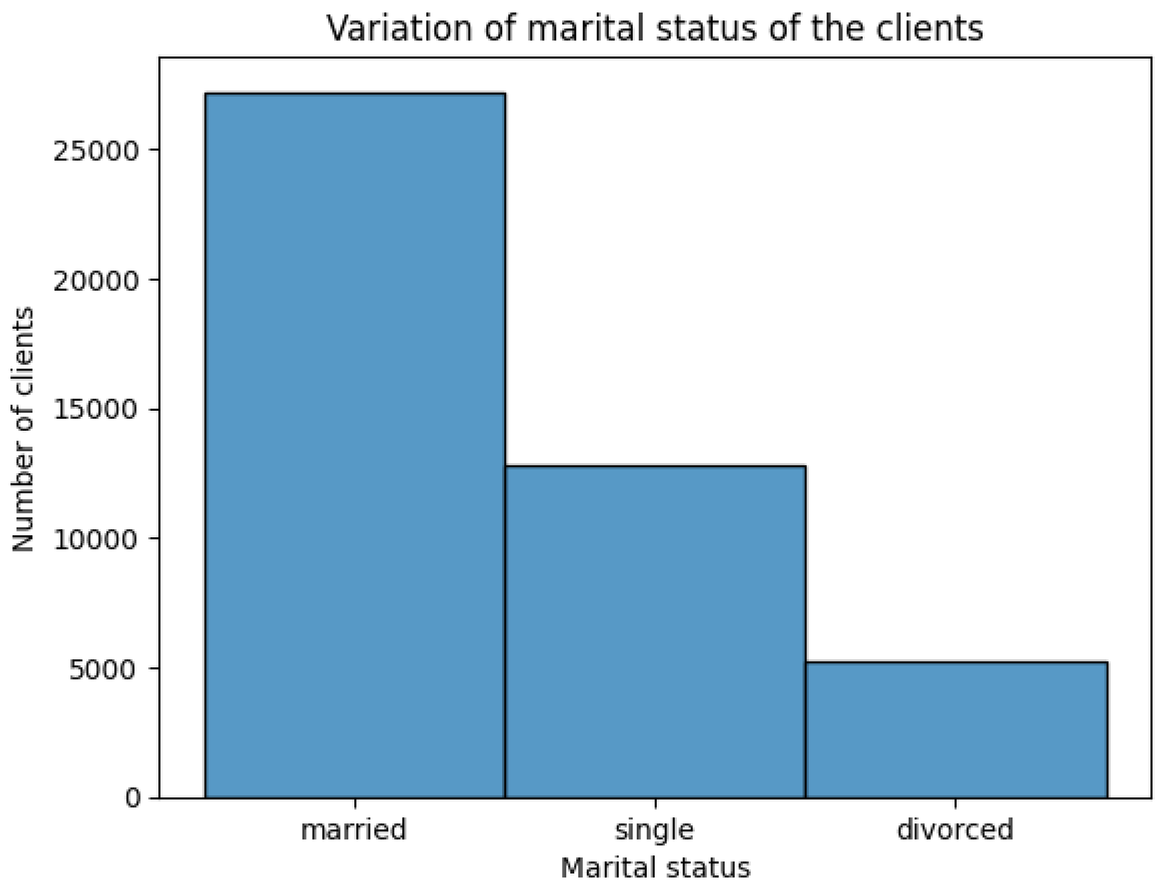
```python
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
from scipy.stats import chi2_contingency

df = pd.read_csv("banking_data.csv")

# Answer 1
sns.histplot(data=df['age'])
plt.title("Distribuiton of age among the clients")
plt.xlabel('Ages')
plt.ylabel("Number of clients")
plt.show()
```



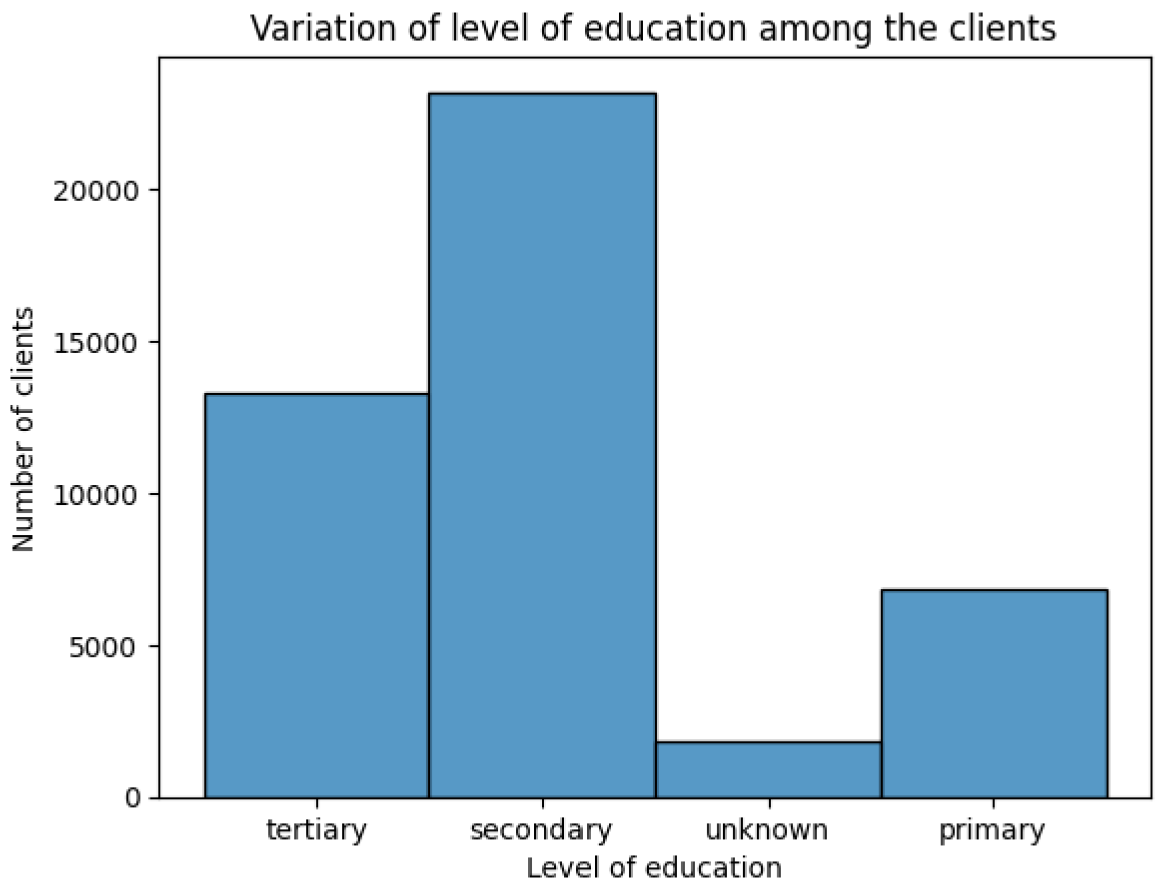

```python
# Answer 2
sns.histplot(data=df['job'])
plt.title("Variation of job type among the clients")
plt.xticks(rotation=45)
plt.xlabel("Job type")
plt.ylabel("Number of clients")
plt.show()
```



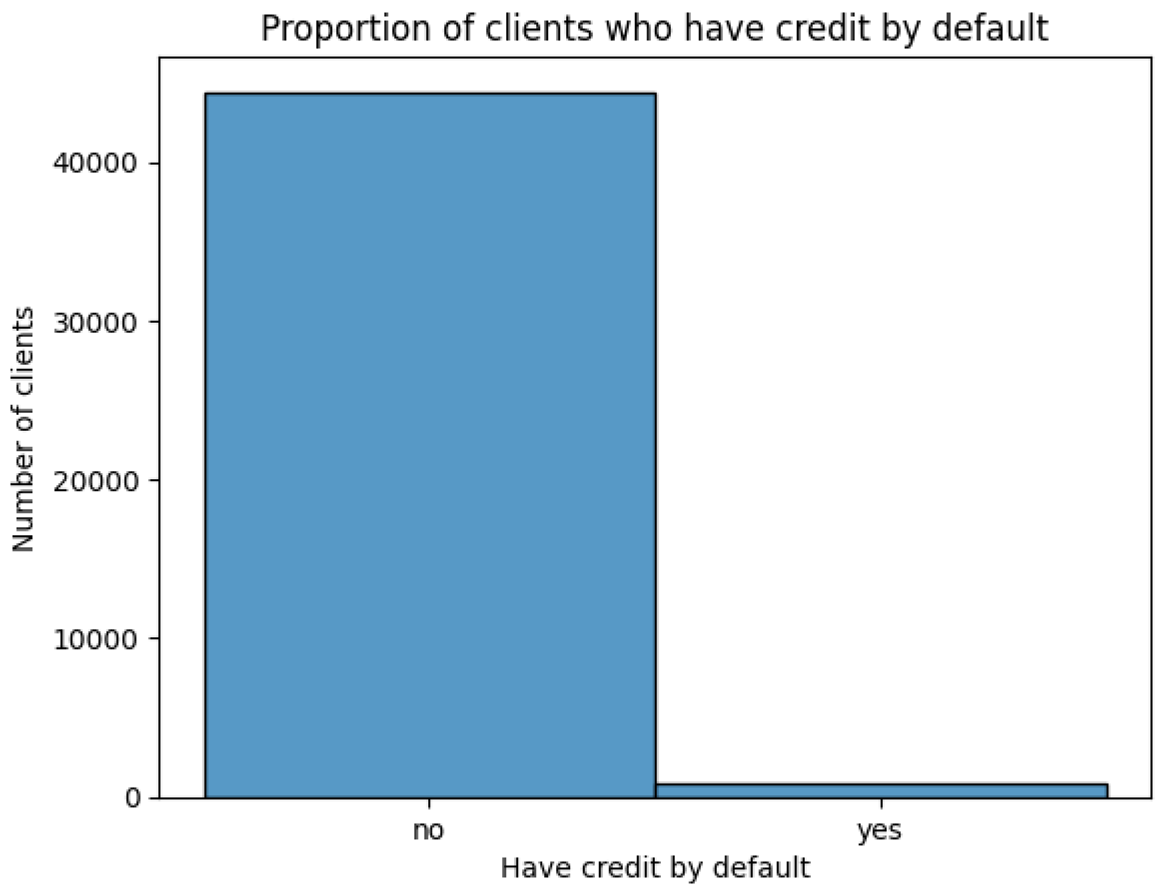

```python
# Answer 3
sns.histplot(data=df['marital'])
plt.title("Variation of marital status of the clients")
plt.xlabel("Marital status")
plt.ylabel("Number of clients")
plt.show()
```



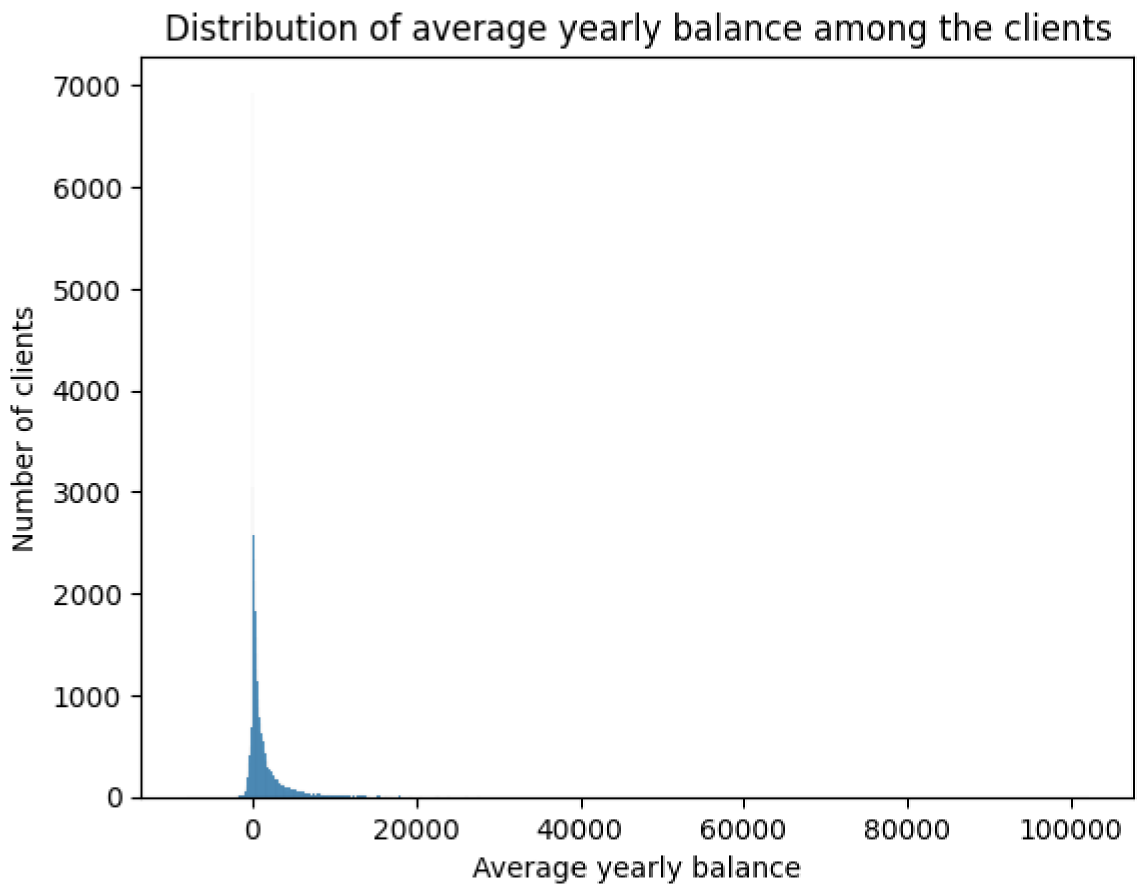

```
# Answer 4
sns.histplot(data=df['education'])
plt.title("Variation of level of education among the clients")
plt.xlabel("Level of education")
plt.ylabel("Number of clients")
plt.show()
```



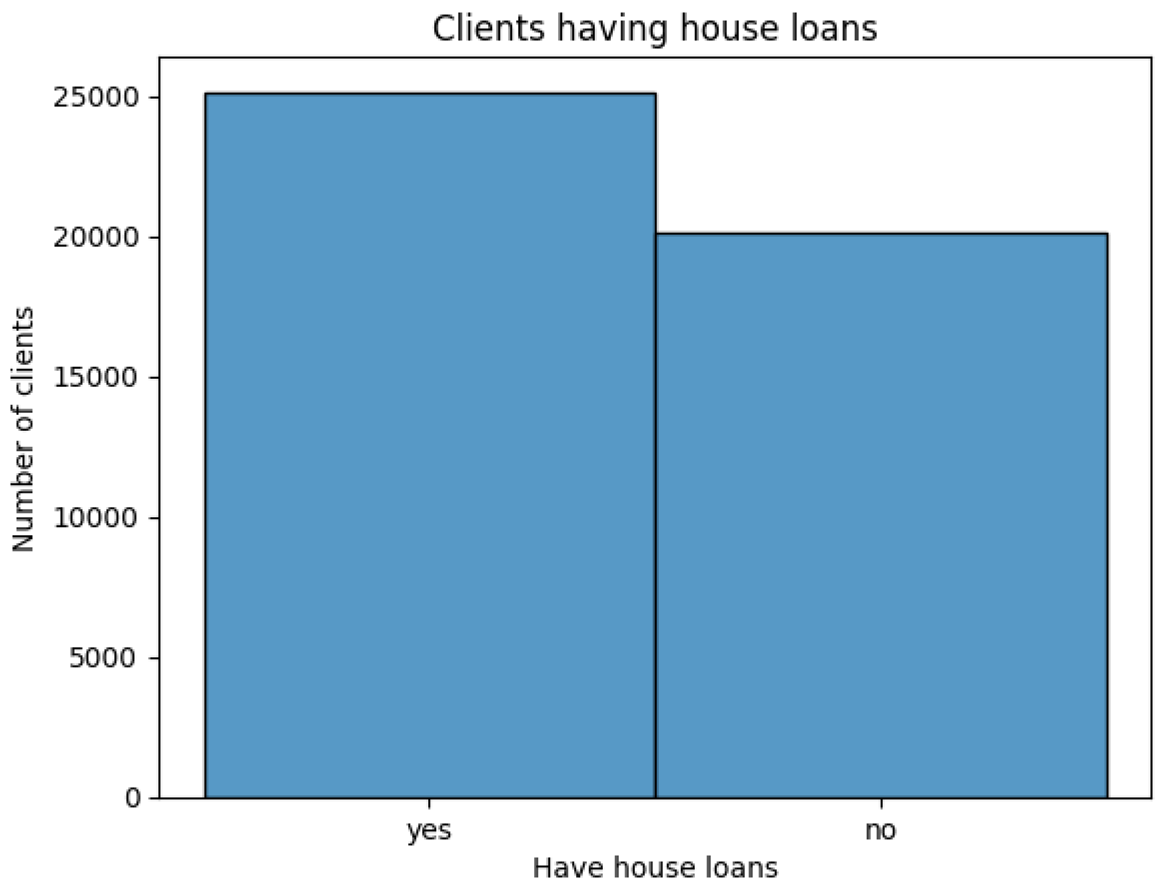

```
# Answer 5
sns.histplot(data=df['default'])
plt.title("Proportion of clients have credit in default")
plt.xlabel("Have credit by default")
plt.ylabel("Number of clients")
plt.show()
```



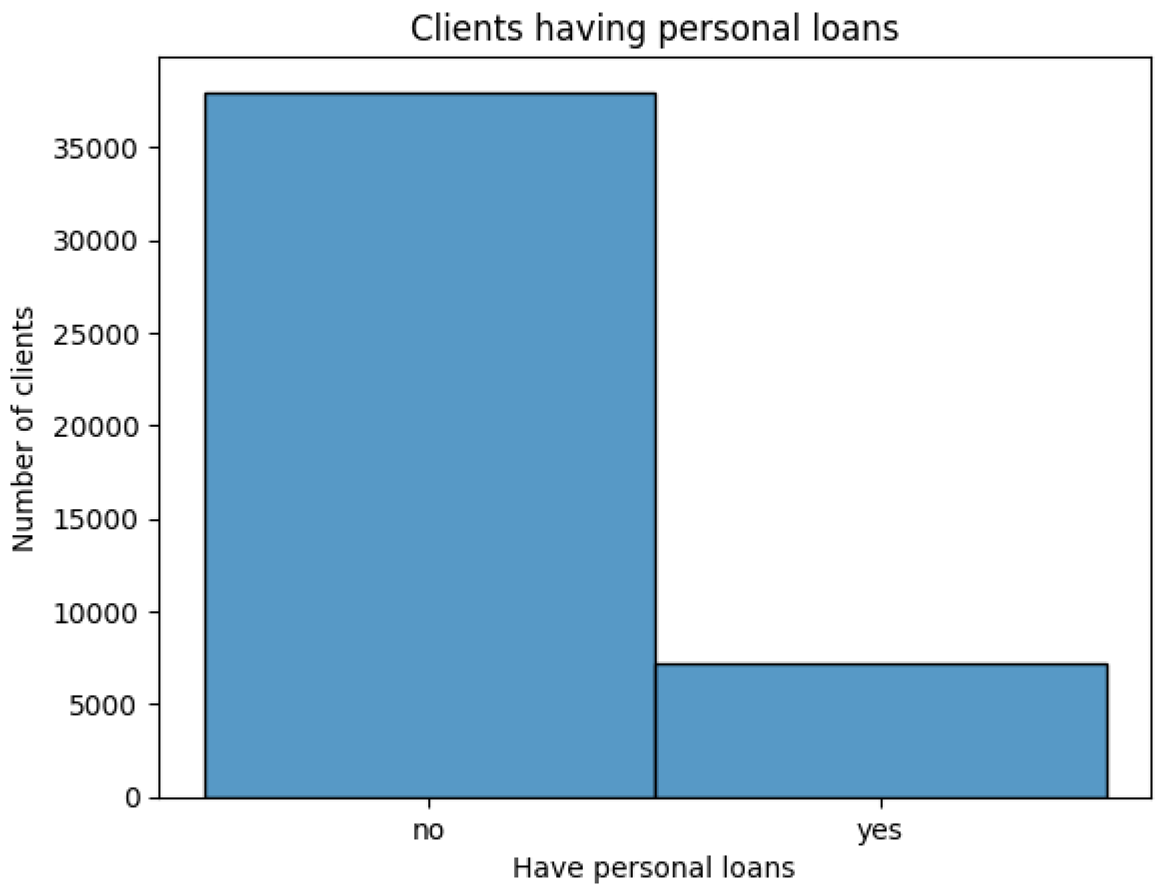

```
# Answer 6
sns.histplot(data=df['balance'])
plt.title("Distribution of average yearly balance among the clients")
plt.xlabel("Average yearly balance")
plt.ylabel("Number of clients")
plt.show()
```



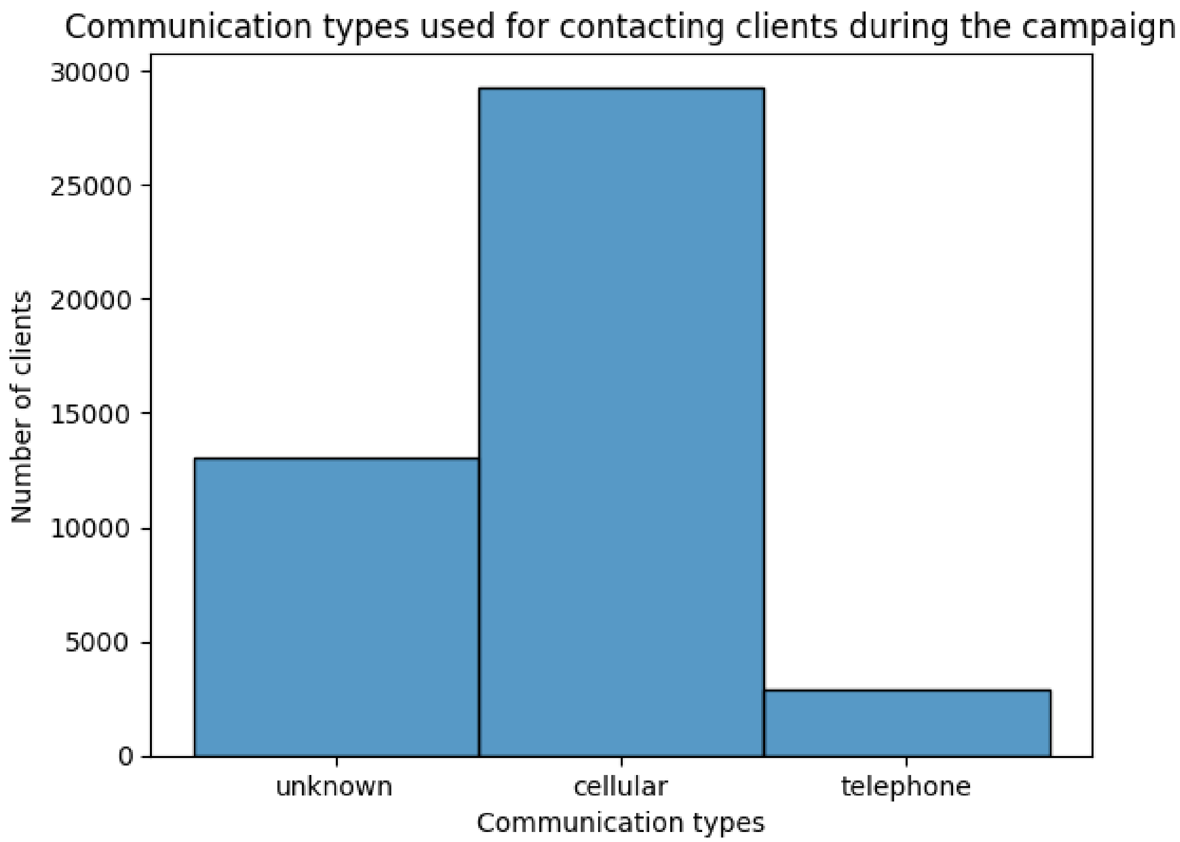

```
# Answer 7
sns.histplot(data=df['housing'])
plt.title("Clients having house loans")
plt.xlabel("Have house loans")
plt.ylabel("Number of clients")
plt.show()
```



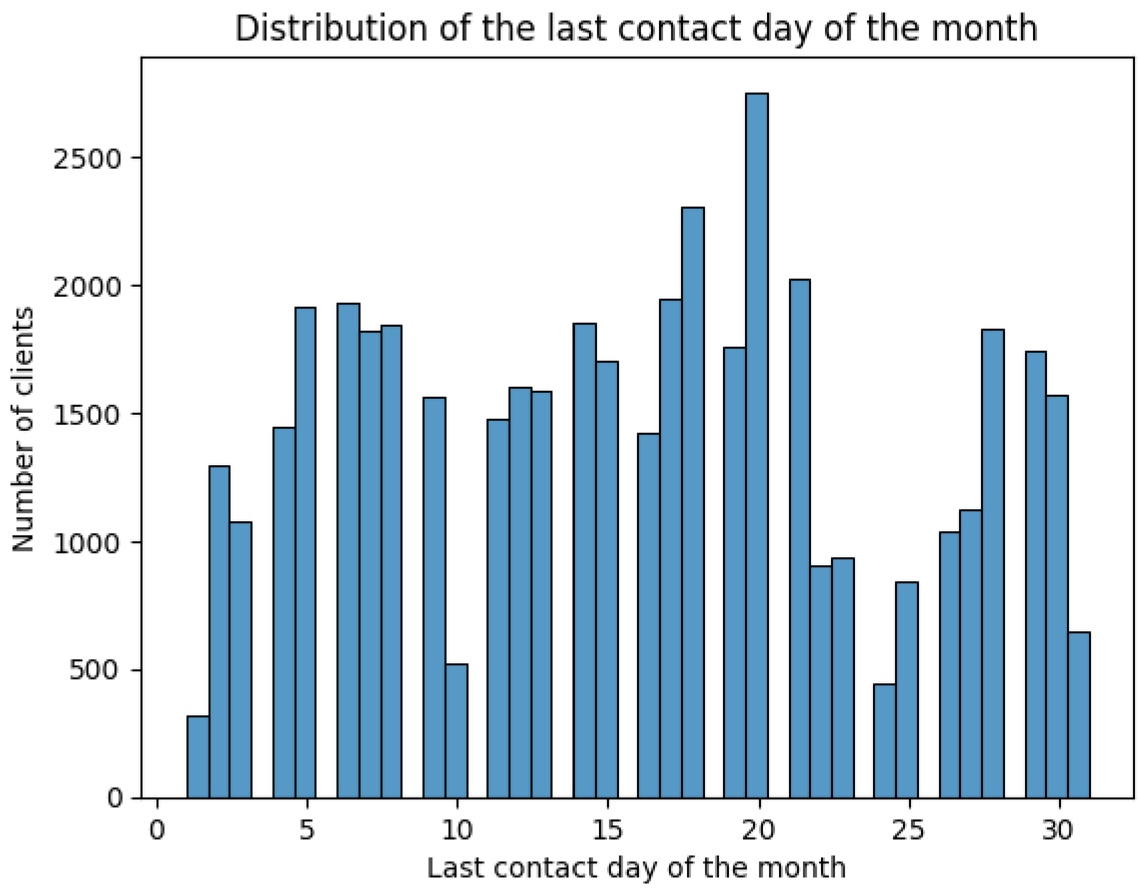

```python
# Answer 8
sns.histplot(data=df['loan'])
plt.title("Clients having personal loans")
plt.xlabel("Have personal loans")
plt.ylabel("Number of clients")
plt.show()
```



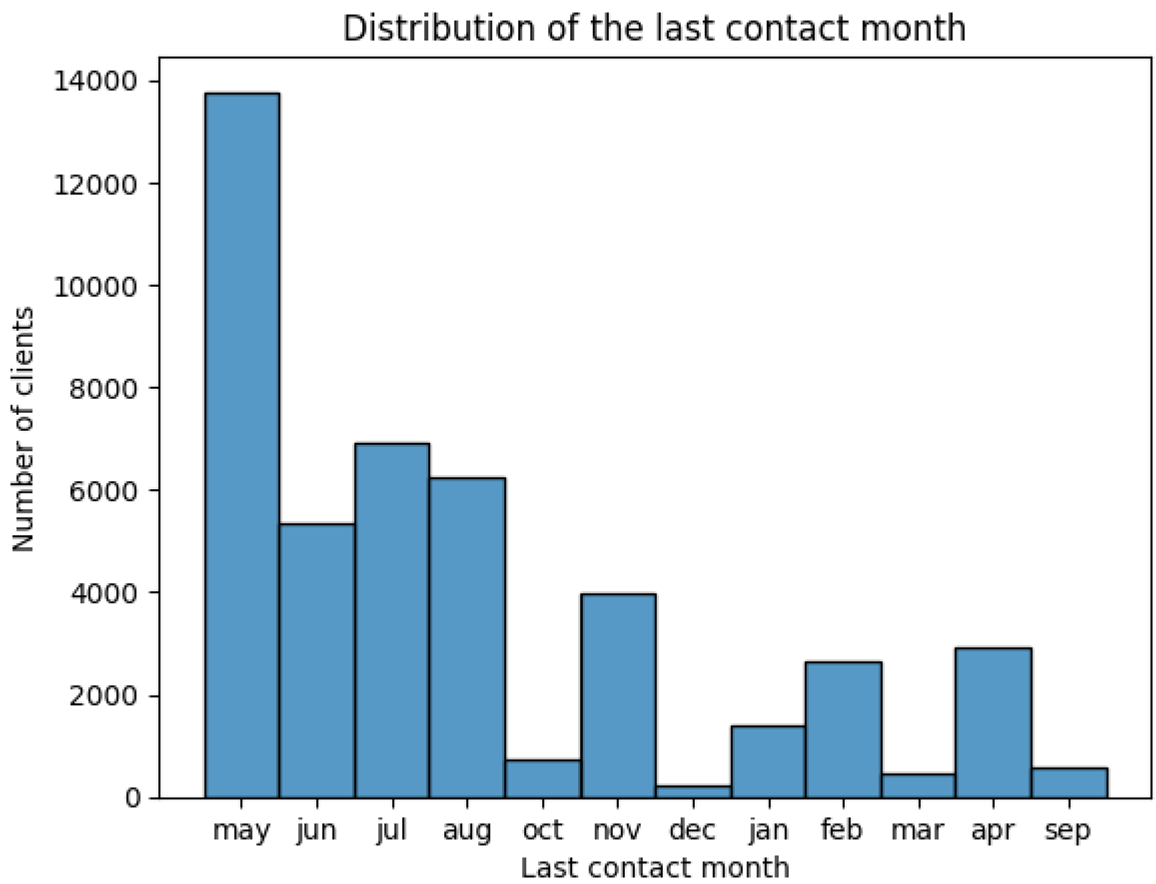

```
# Answer 9
sns.histplot(data=df['contact'])
plt.title("Communication types used for contacting clients during the campaign")
plt.xlabel("Communication types")
plt.ylabel("Number of clients")
plt.show()
```



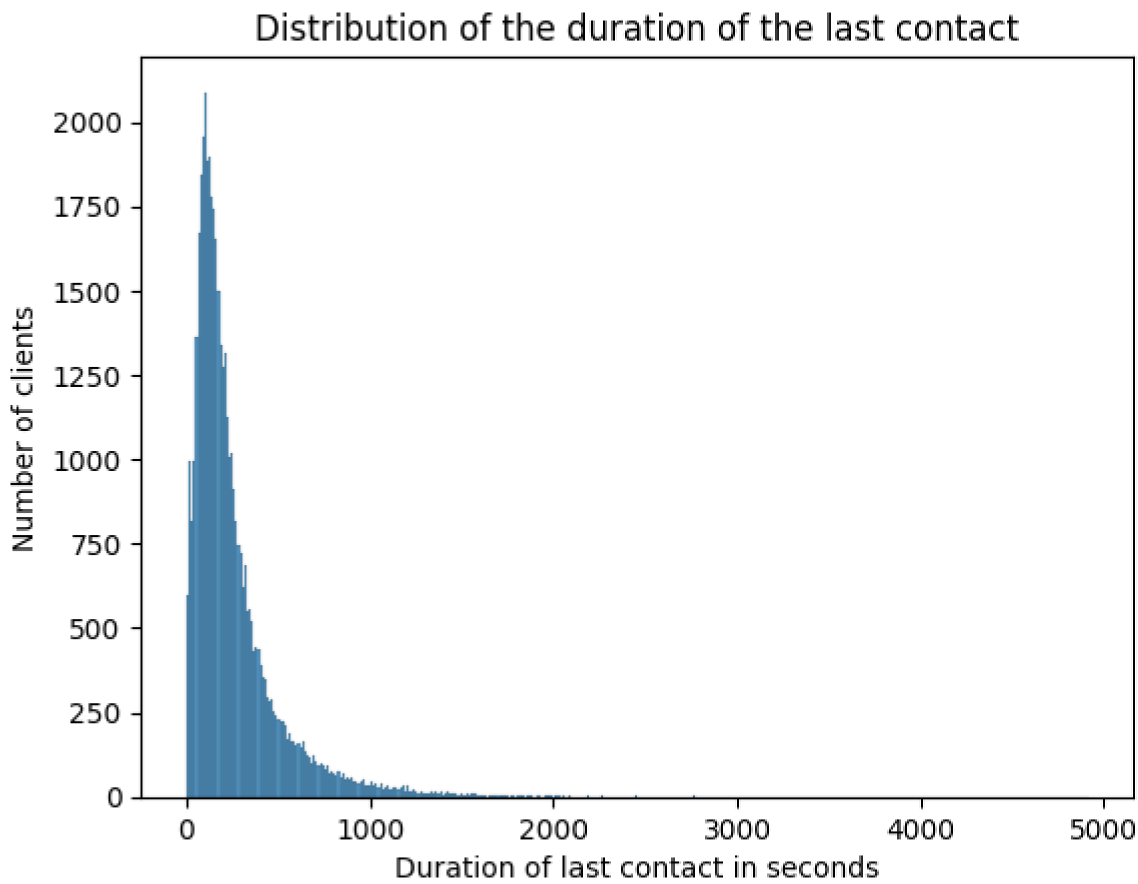

```
# Answer 10
sns.histplot(data=df['day'])
plt.title("Distribution of the last contact day of the month")
plt.xlabel("Last contact day of the month")
plt.ylabel("Number of clients")
plt.show()
```



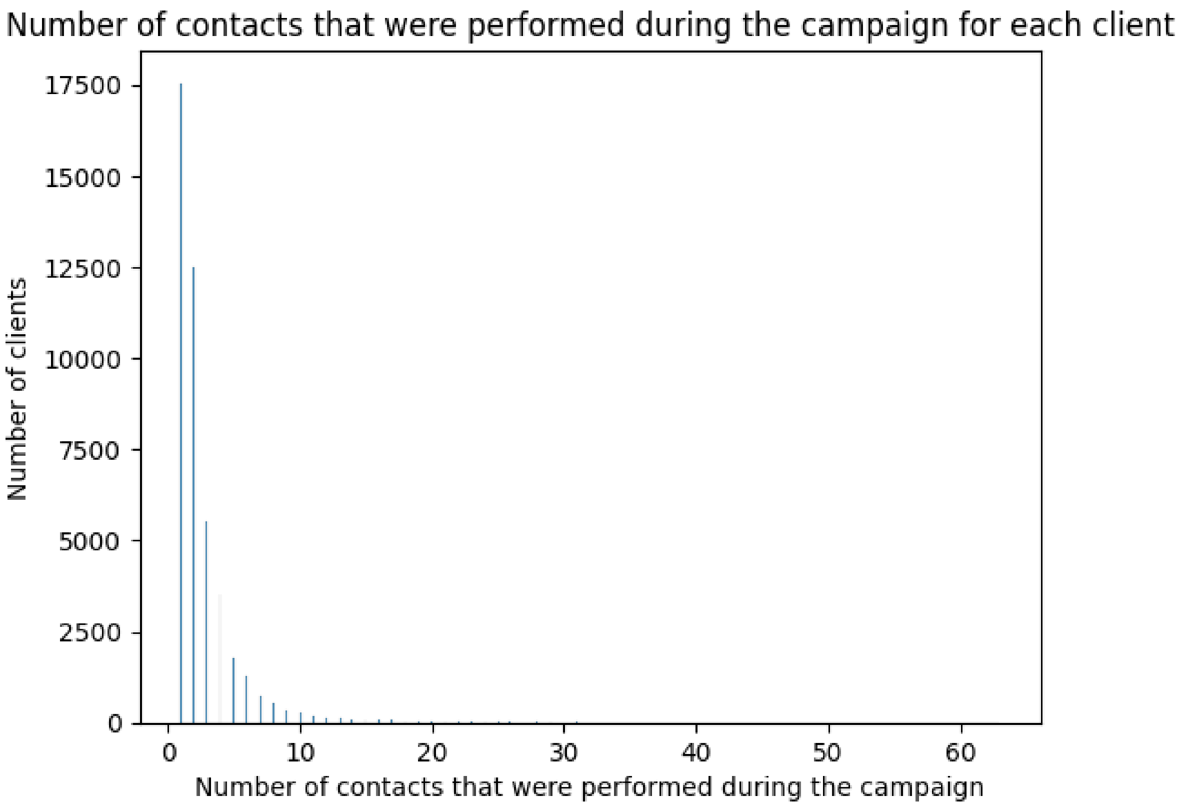

```
# Answer 11
sns.histplot(data=df['month'])
plt.title("Distribution of the last contact month")
plt.xlabel("Last contact month")
plt.ylabel("Number of clients")
plt.show()
```



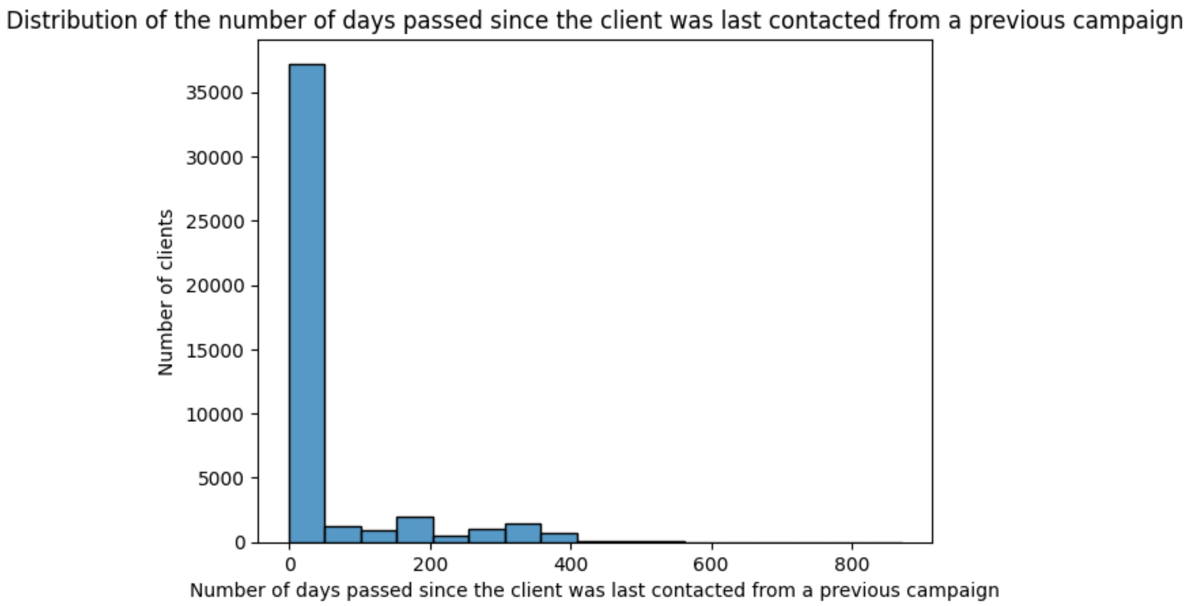

```
# Answer 12
sns.histplot(data=df['duration'])
plt.title("Distribution of the duration of the last contact")
plt.xlabel("Duration of last contact in seconds")
plt.ylabel("Number of clients")
plt.show()
```



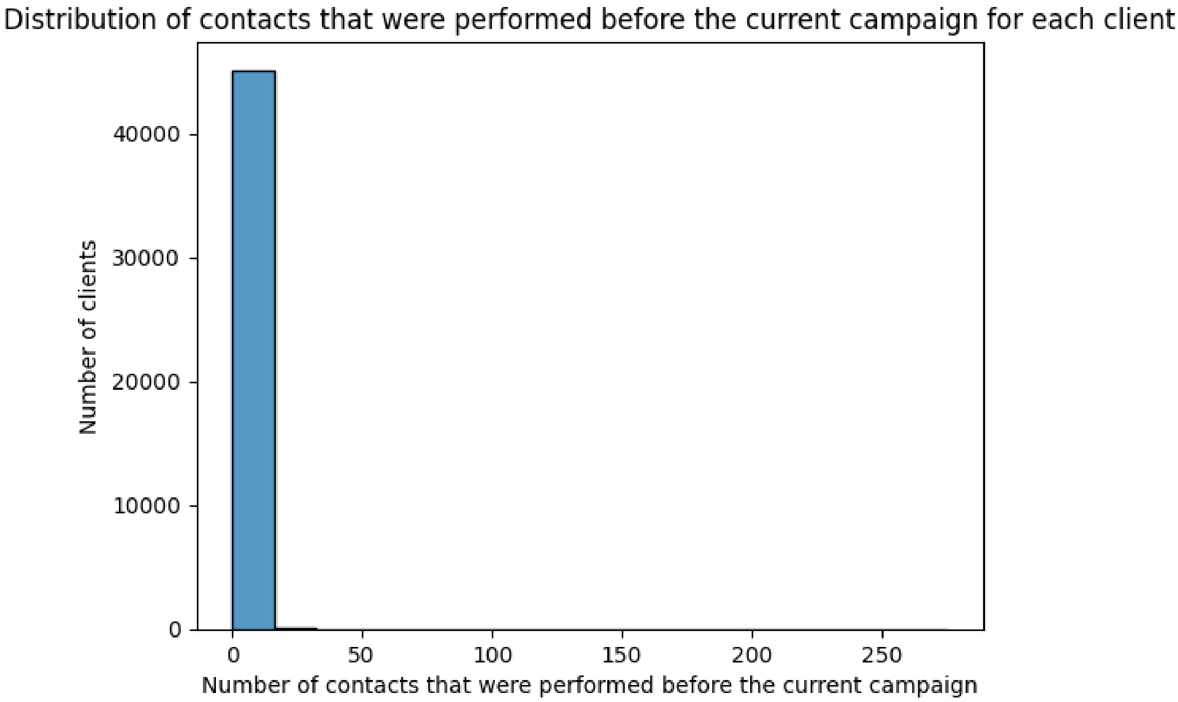

```
# Answer 13
sns.histplot(data=df['campaign'])
plt.title("Number of contacts that were performed during the campaign for each client")
plt.xlabel("Number of contacts that were performed during the campaign")
plt.ylabel("Number of clients")
plt.show()
```



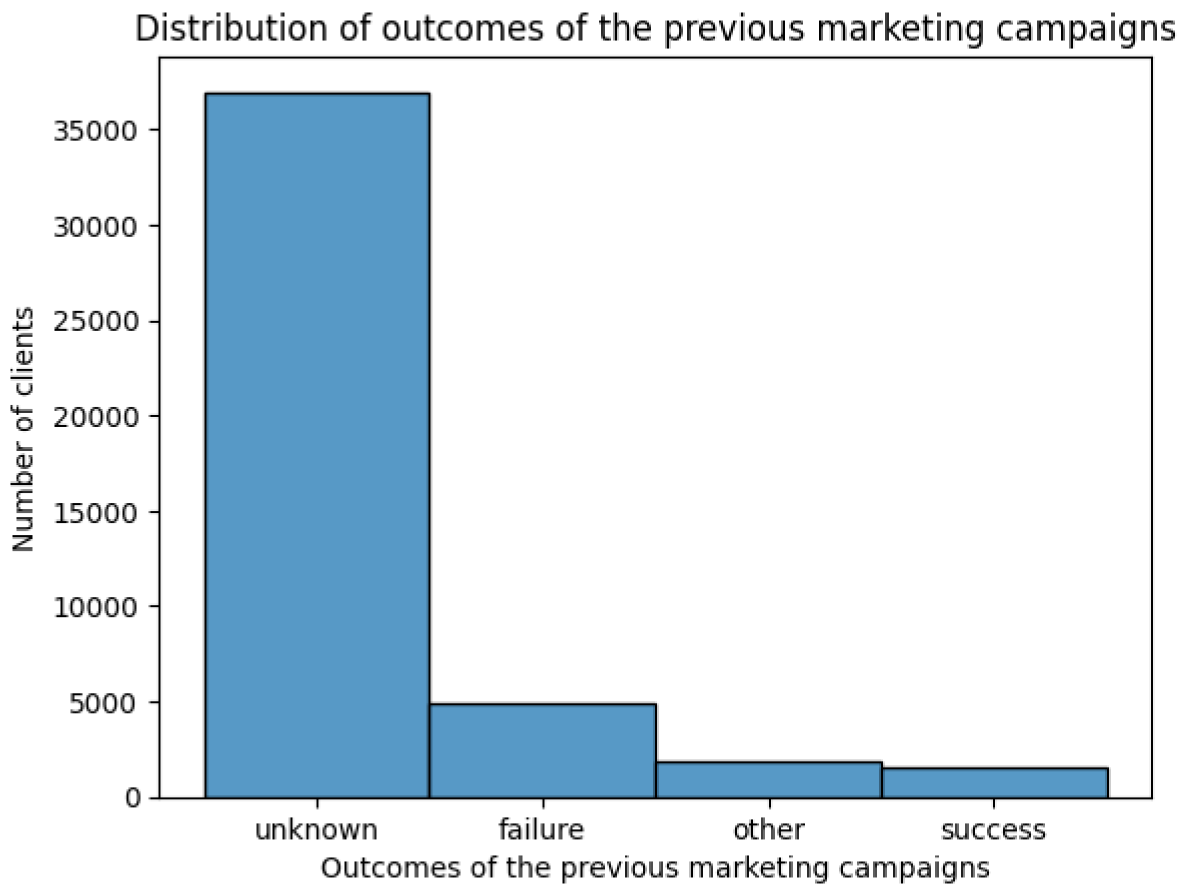

```python
# Answer 14
sns.histplot(data=df['pdays'])
plt.title("Distribution of the number of days passed since the client was last contacted from a previous campaign")
plt.xlabel("Number of days passed since the client was last contacted from a previous campaign")
plt.ylabel("Number of clients")
plt.show()
```



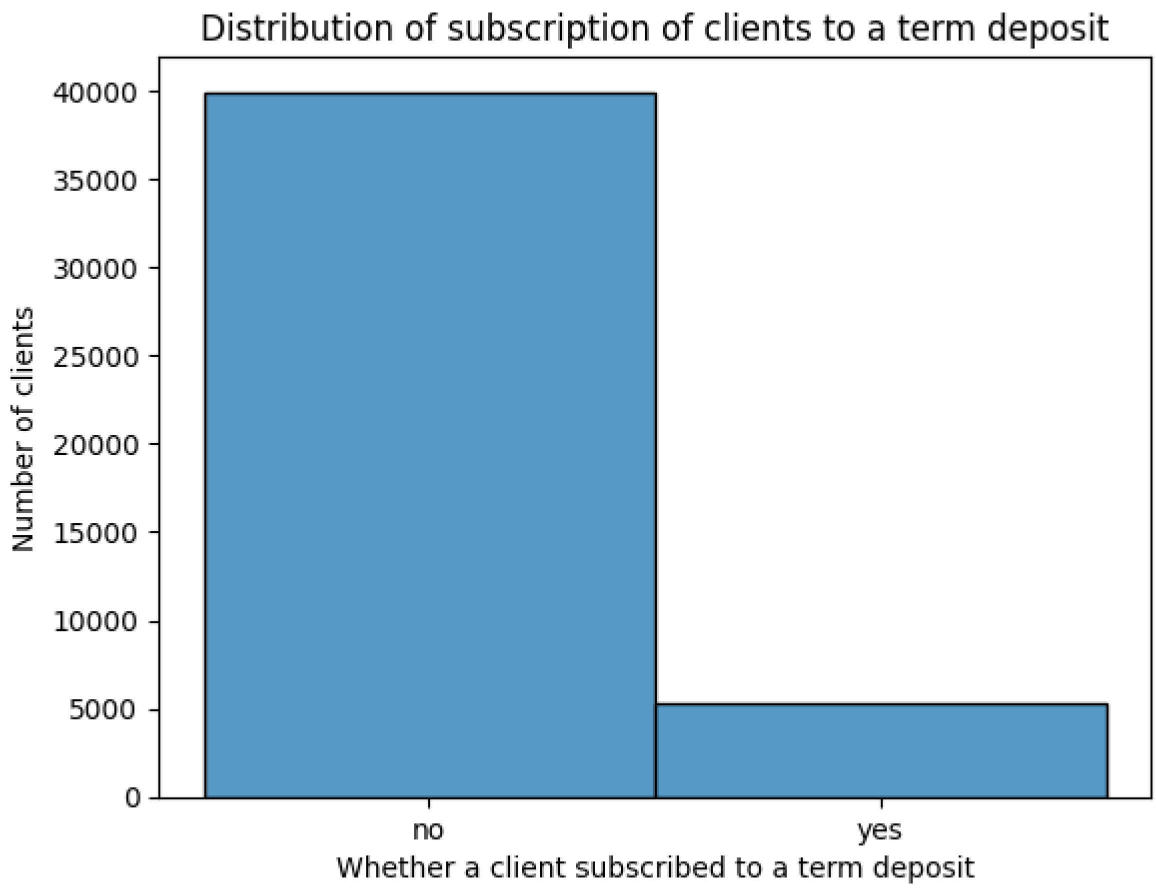
```python
# Answer 15
sns.histplot(data=df['previous'])
plt.title("Distribution of contacts that were performed before the current campaign for each client")
plt.xlabel("Number of contacts that were performed before the current campaign")
plt.ylabel("Number of clients")
plt.show()
```



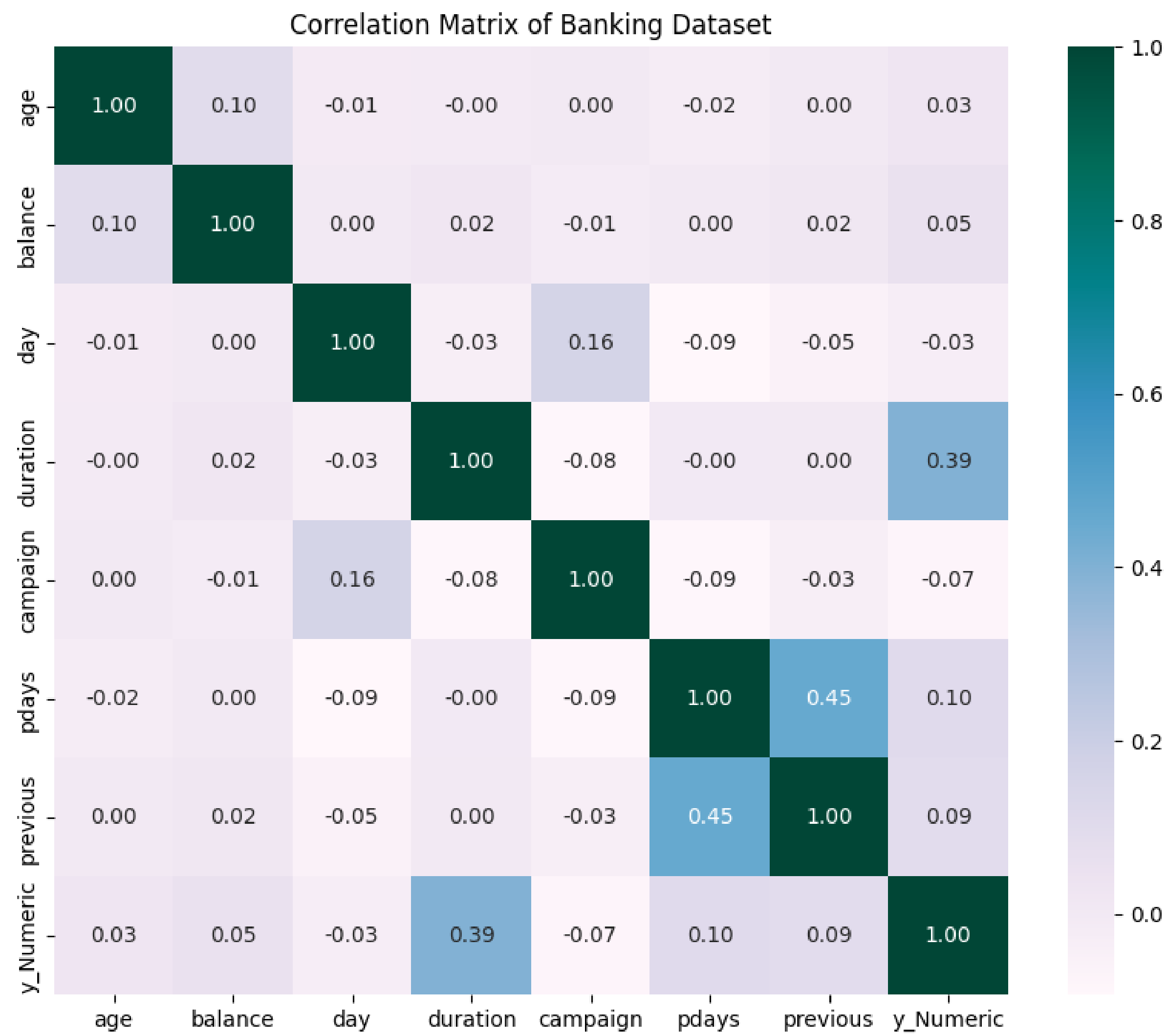

```python
# Answer 16
sns.histplot(data=df['poutcome'])
plt.title("Distribution of outcomes of the previous marketing campaigns")
plt.xlabel("Outcomes of the previous marketing campaigns")
plt.ylabel("Number of clients")
plt.show()
```



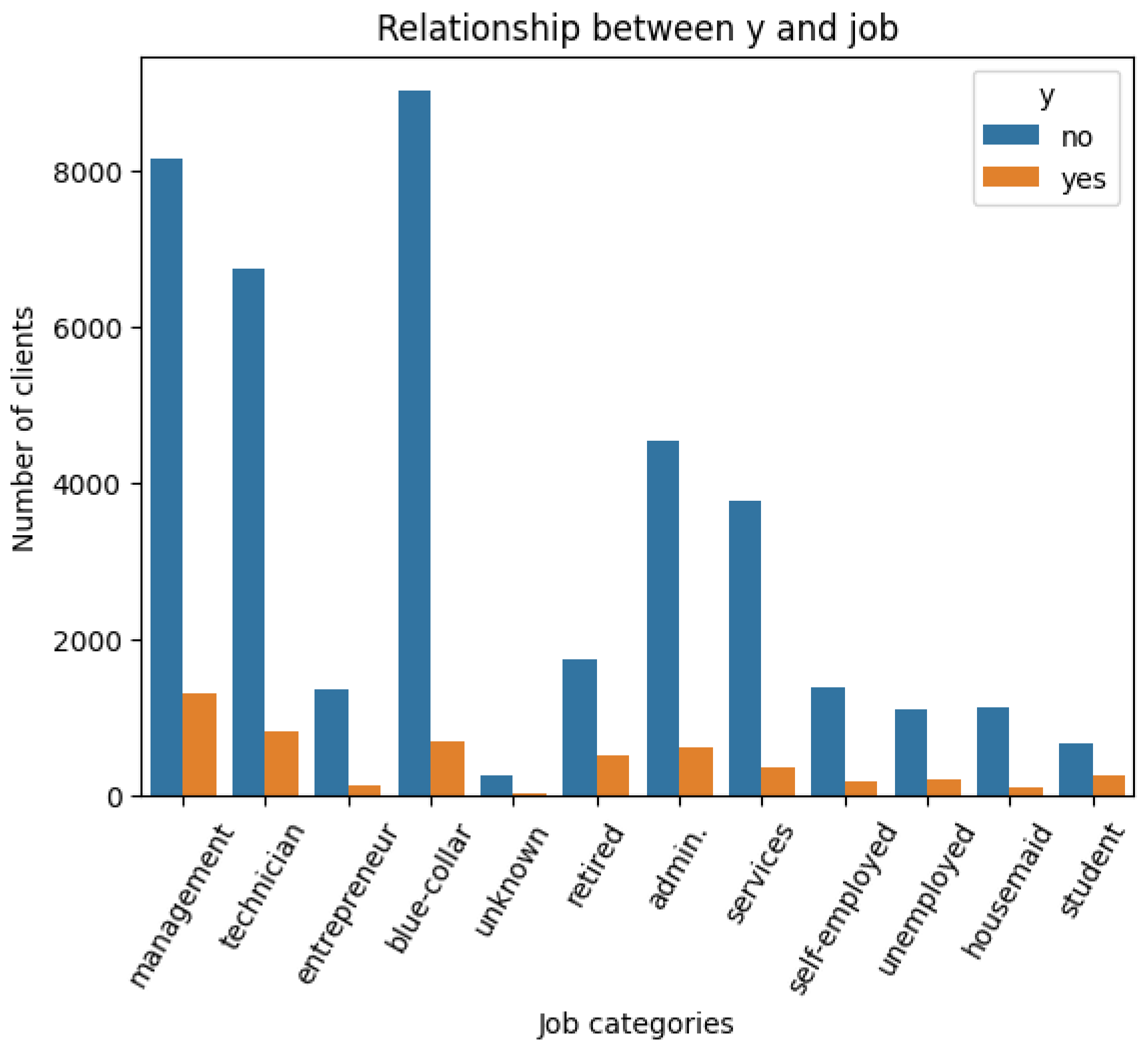

```
# Answer 17
sns.histplot(data=df['y'])
plt.title("Distribution of subscription of clients to a term deposit")
plt.xlabel("Whether a client subscribed to a term deposit")
plt.ylabel("Number of clients")
plt.show()
```




```
# Answer 18
# Replacing "yes" and "no" with 1 and 0 in the "y" column so that it gets
included in all the numeric variables used in the correlation matrix
df['y_Numeric'] = df['y'].map({"yes":1, "no":0})
numeric_df = df.select_dtypes(include=['int64', 'float64'])
corr_matrix = numeric_df.corr()
plt.figure(figsize=(10, 8)) # Height-width figure size
sns.heatmap(corr_matrix, annot=True, cmap='PuBuGn', fmt='.2f') # Pu is purple,
Bu is blue and Gn is green. Pu is highest negative correlation and Gn is
highest positive correlation.
plt.title('Correlation Matrix of Banking Dataset')
plt.show()

# Non numeric variables : job, marital, education, default, housing, loan,
contact, month, poutcome
```




```
# Answer 18 : Relationship between job and y
sns.countplot(x='job', hue='y', data=df)
plt.title("Relationship between y and job")
plt.xlabel("Job categories")
plt.xticks(rotation=60)
plt.ylabel("Number of clients")
plt.show()

# Applying the chi square test of independence on job type and y
contingency_Table = pd.crosstab(df['job'], df['y'])
chi2, p, dof, expected = chi2_contingency(contingency_Table)
alpha = 0.05
print(f'Chi-square statistic: {chi2}')
print(f'P-value: {p}')
if p <= alpha:
    print("Reject the null hypothesis: There is a significant association
between the variables.")
else:
    print("Fail to reject the null hypothesis: There is no significant
association between the variables.")
```



Output -

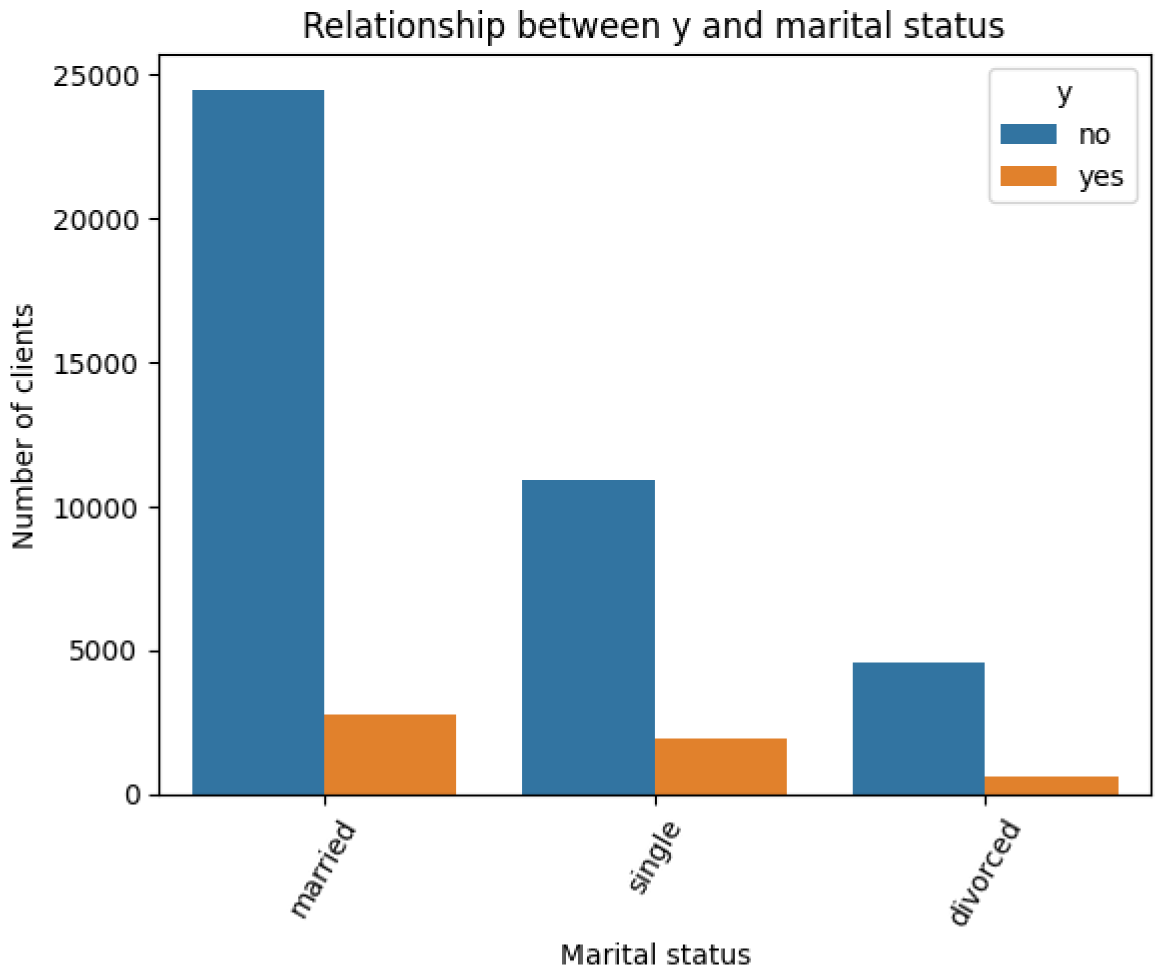
Chi-square statistic: 841.5452614002221

P-value: 2.2635164806103493e-173

Reject the null hypothesis: There is a significant association between the variables.

```
# Answer 18 : Relationship between marital status and y
sns.countplot(x='marital', hue='y', data=df)
plt.title("Relationship between y and marital status")
plt.xlabel("Marital status")
plt.xticks(rotation=60)
plt.ylabel("Number of clients")
plt.show()

# Applying the chi square test of independence on marital status and y
contingency_Table = pd.crosstab(df['marital'], df['y'])
chi2, p, dof, expected = chi2_contingency(contingency_Table)
```

```
alpha = 0.05
print(f'Chi-square statistic: {chi2}')
print(f'P-value: {p}')
if p <= alpha:
    print("Reject the null hypothesis: There is a significant association 
between the variables.")
else:
    print("Fail to reject the null hypothesis: There is no significant 
association between the variables.")
```



Output –

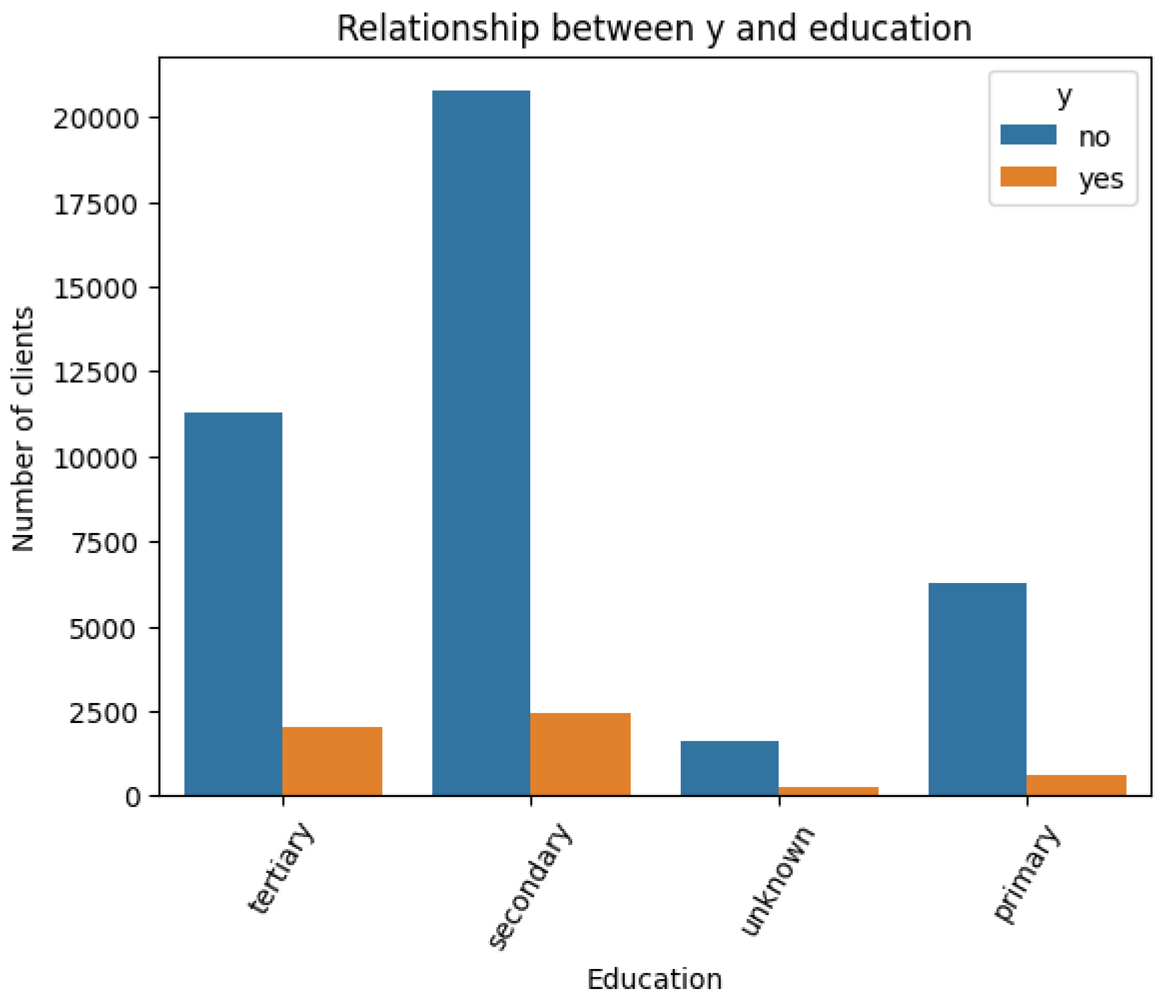
Chi-square statistic: 196.17206575615654

P-value: 2.5221863401197422e-43

Reject the null hypothesis: There is a significant association between the variables.

```
# Answer 18 : Relationship between education and y
sns.countplot(x='education', hue='y', data=df)
plt.title("Relationship between y and education")
plt.xlabel("Education")
```

```python
plt.xticks(rotation=60)
plt.ylabel("Number of clients")
plt.show()

# Applying the chi square test of independence on education and y
contingency_Table = pd.crosstab(df['education'], df['y'])
chi2, p, dof, expected = chi2_contingency(contingency_Table)
alpha = 0.05
print(f'Chi-square statistic: {chi2}')
print(f'P-value: {p}')
if p <= alpha:
    print("Reject the null hypothesis: There is a significant association
between the variables.")
else:
    print("Fail to reject the null hypothesis: There is no significant
association between the variables.")
```



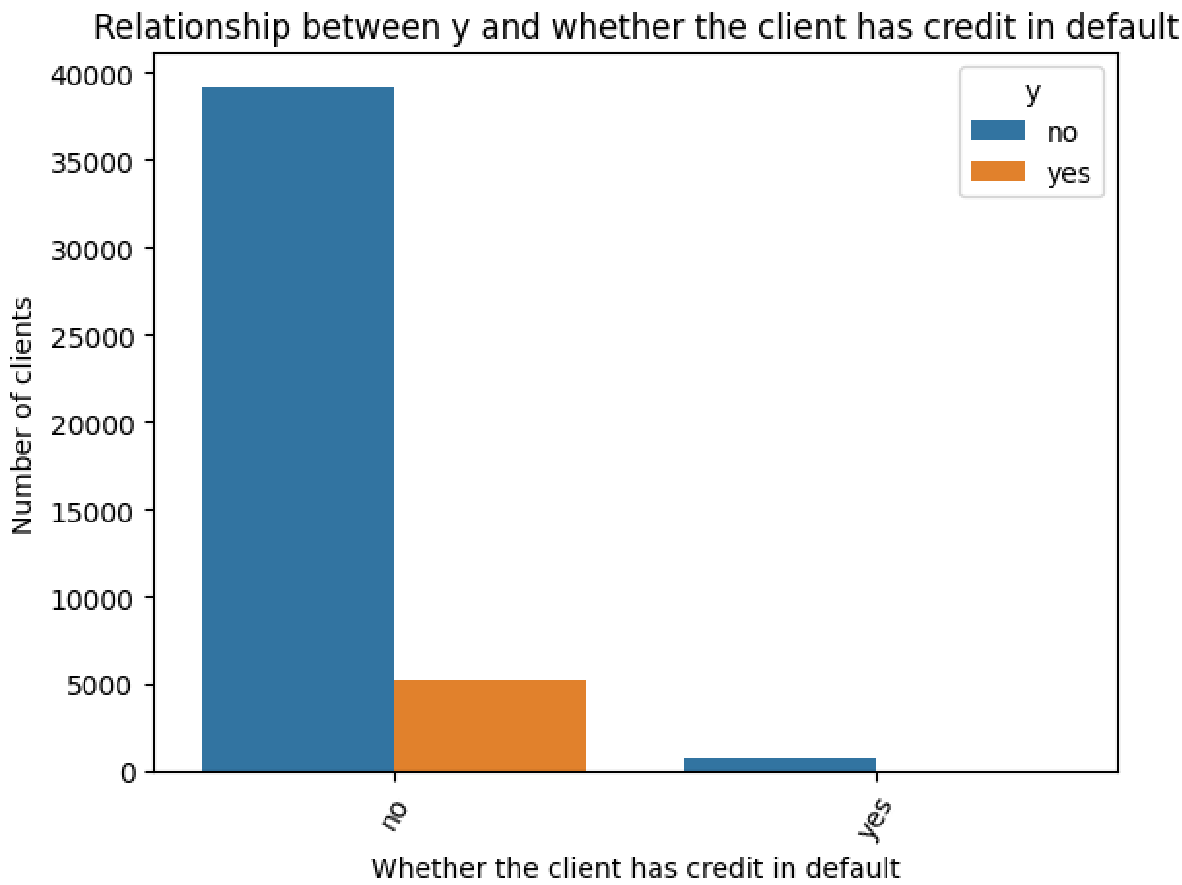
Output -

Chi-square statistic: 238.43038031391868

P-value: 2.079369947995951e-51

Reject the null hypothesis: There is a significant association between the variables.

```
# Answer 18 : Relationship between whether the client has credit in default
and y
sns.countplot(x='default', hue='y', data=df)
plt.title("Relationship between y and whether the client has credit in
default")
plt.xlabel("Whether the client has credit in default")
plt.xticks(rotation=60)
plt.ylabel("Number of clients")
plt.show()

# Non numeric variables : job, marital, education, default, housing, loan,
contact, month, poutcome

# Applying the chi square test of independence on job type and y
contingency_Table = pd.crosstab(df['default'], df['y'])
chi2, p, dof, expected = chi2_contingency(contingency_Table)
alpha = 0.05
print(f'Chi-square statistic: {chi2}')
print(f'P-value: {p}')
if p <= alpha:
    print("Reject the null hypothesis: There is a significant association
between the variables.")
else:
    print("Fail to reject the null hypothesis: There is no significant
association between the variables.")
```

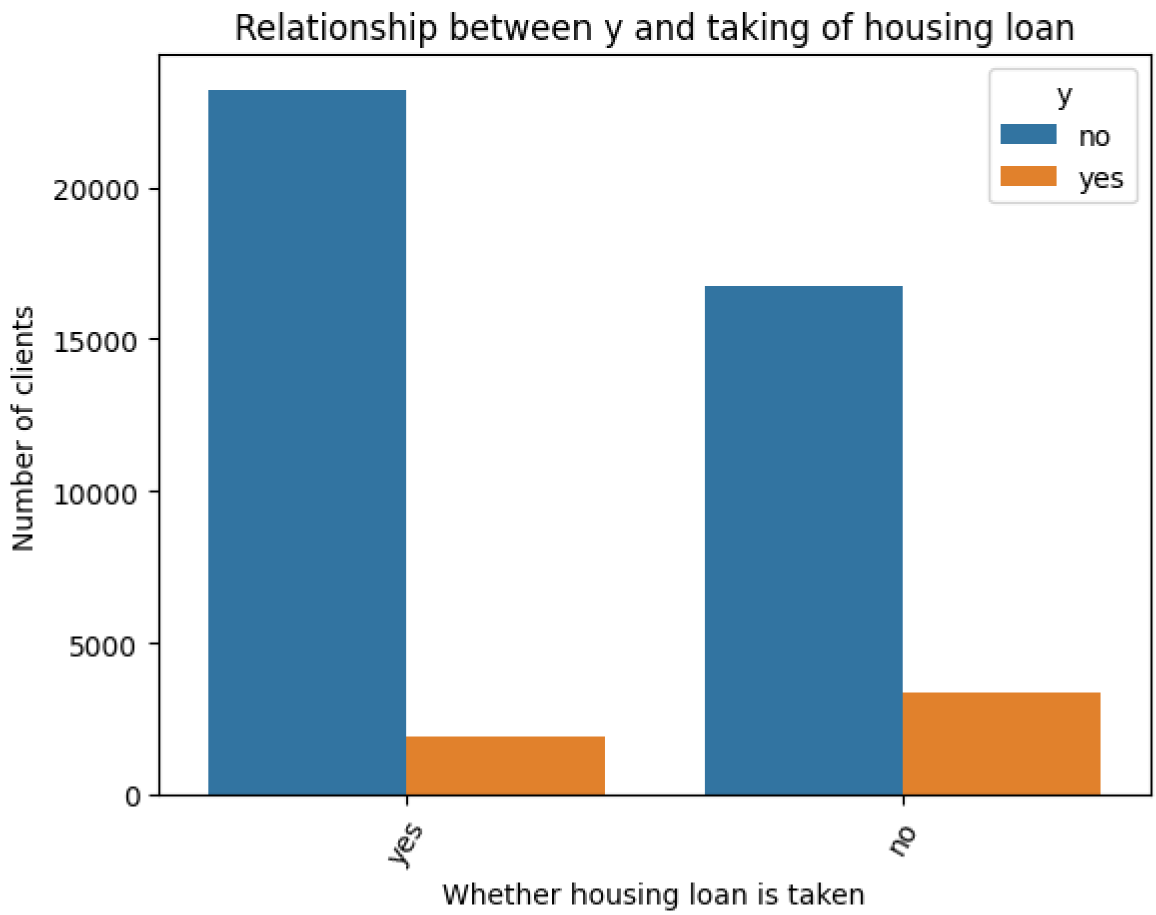


Output –

Chi-square statistic: 22.268639949059025 P-value: 2.3704645045981514e-06
Reject the null hypothesis: There is a significant association between the variables.

```
# Answer 18 : Relationship between housing loan and y
sns.countplot(x='housing', hue='y', data=df)
plt.title("Relationship between y and taking of housing loan")
plt.xlabel("Whether housing loan is taken")
plt.xticks(rotation=60)
plt.ylabel("Number of clients")
plt.show()

# Non numeric variables : job, marital, education, default, housing, loan,
contact, month, poutcome

# Applying the chi square test of independence on housing loan and y
contingency_Table = pd.crosstab(df['housing'], df['y'])
chi2, p, dof, expected = chi2_contingency(contingency_Table)
alpha = 0.05
print(f'Chi-square statistic: {chi2}')
print(f'P-value: {p}')
if p <= alpha:
```

```
    print("Reject the null hypothesis: There is a significant association between the variables.")
else:
    print("Fail to reject the null hypothesis: There is no significant association between the variables.")
```



Output –

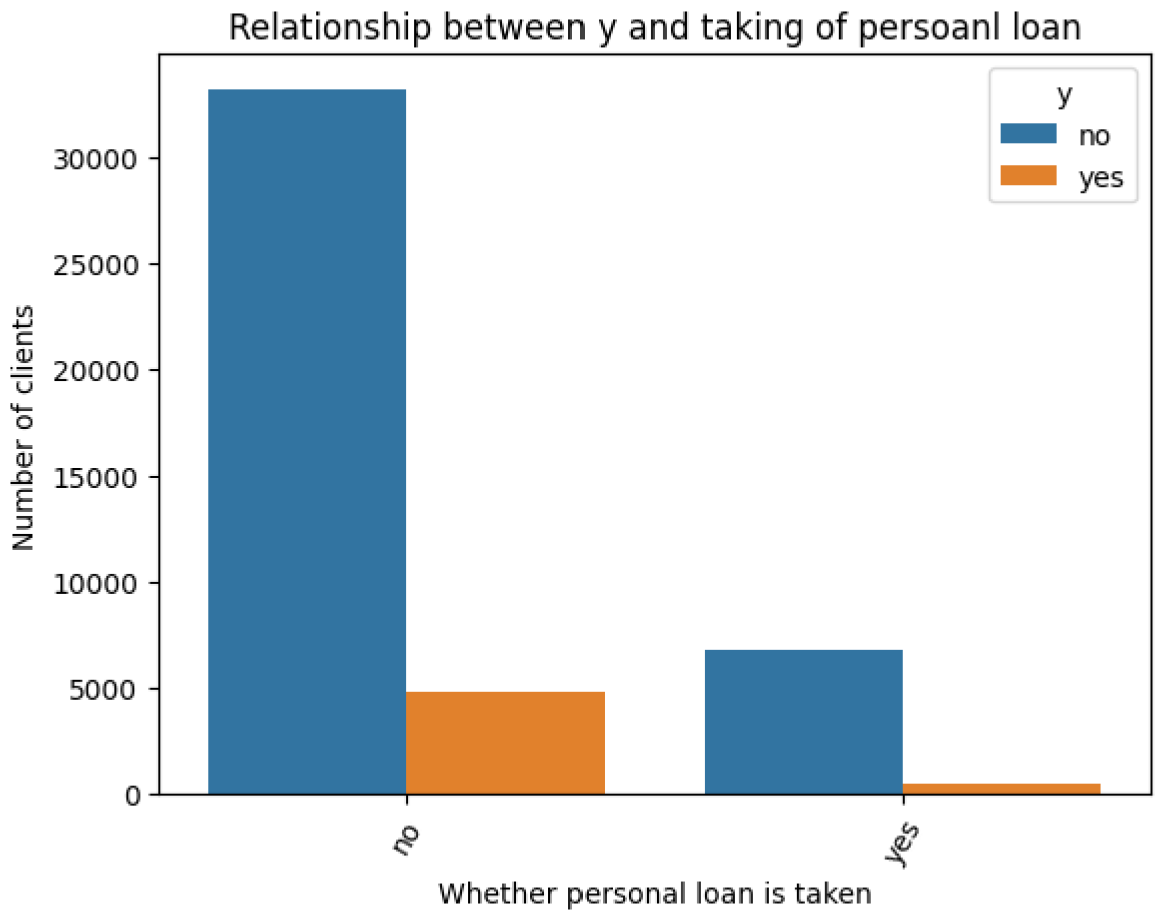
Chi-square statistic: 878.3448825348537

P-value: 5.005490373278558e-193

Reject the null hypothesis: There is a significant association between the variables.

```
# Answer 18 : Relationship between personal loan and y
sns.countplot(x='loan', hue='y', data=df)
plt.title("Relationship between y and taking of persoanl loan")
plt.xlabel("Whether personal loan is taken")
plt.xticks(rotation=60)
plt.ylabel("Number of clients")
plt.show()
```

```
# Non numeric variables : job, marital, education, default, housing, loan, contact, month, poutcome

# Applying the chi square test of independence on personal loan and y
contingency_Table = pd.crosstab(df['loan'], df['y'])
chi2, p, dof, expected = chi2_contingency(contingency_Table)
alpha = 0.05
print(f'Chi-square statistic: {chi2}')
print(f'P-value: {p}')
if p <= alpha:
    print("Reject the null hypothesis: There is a significant association between the variables.")
else:
    print("Fail to reject the null hypothesis: There is no significant association between the variables.")
```



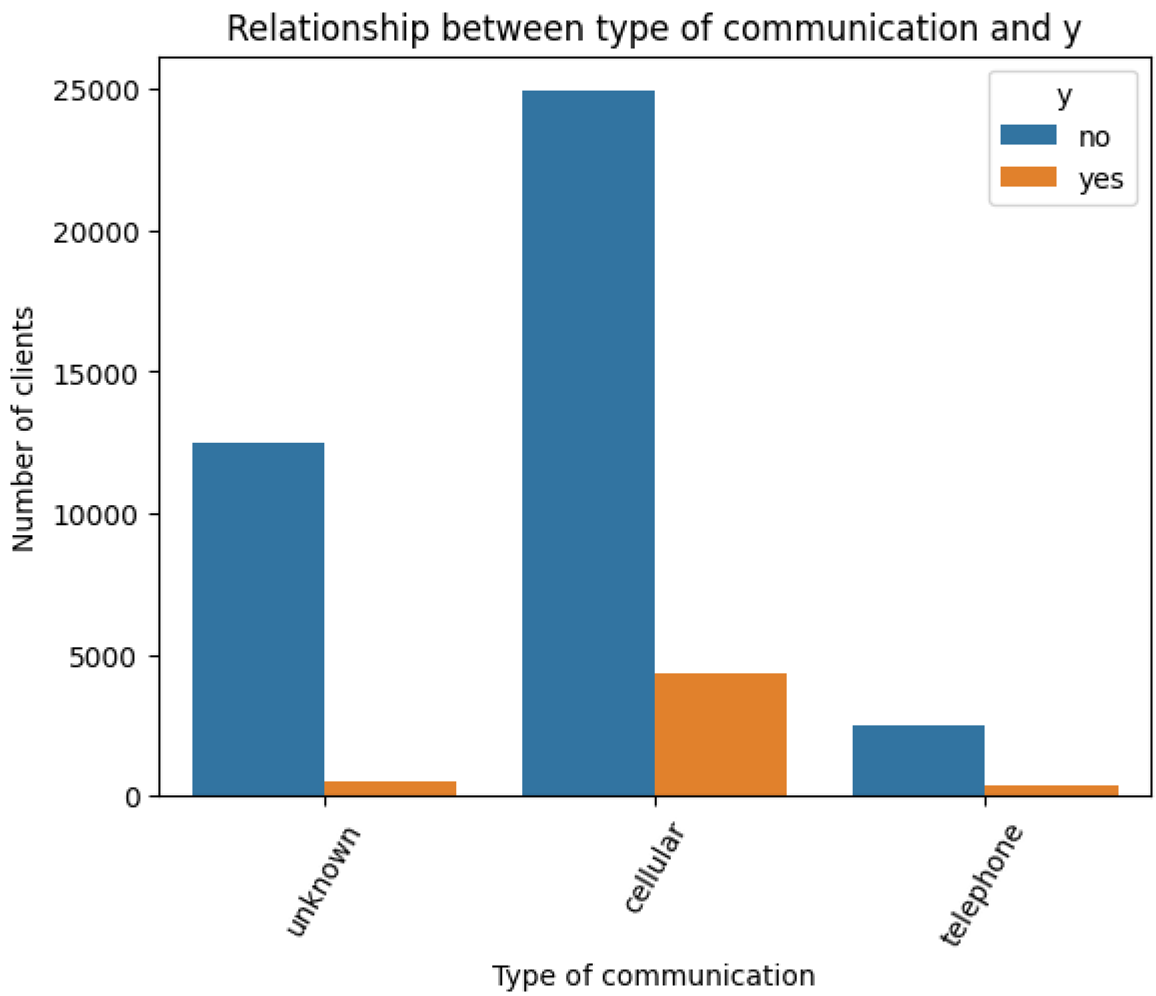
Output -

Chi-square statistic: 210.27814514589792

P-value: 1.1944902411150737e-47

Reject the null hypothesis: There is a significant association between the variables.

```
# Answer 18 : Relationship between type of communication and y
sns.countplot(x='contact', hue='y', data=df)
plt.title("Relationship between type of communication and y")
plt.xlabel("Type of communication")
plt.xticks(rotation=60)
plt.ylabel("Number of clients")
plt.show()

# Non numeric variables : job, marital, education, default, housing, loan,
contact, month, poutcome

# Applying the chi square test of independence on type of communication and y
contingency_Table = pd.crosstab(df['contact'], df['y'])
chi2, p, dof, expected = chi2_contingency(contingency_Table)
alpha = 0.05
print(f'Chi-square statistic: {chi2}')
print(f'P-value: {p}')
if p <= alpha:
    print("Reject the null hypothesis: There is a significant association
between the variables.")
else:
    print("Fail to reject the null hypothesis: There is no significant
association between the variables.")
```



Output –

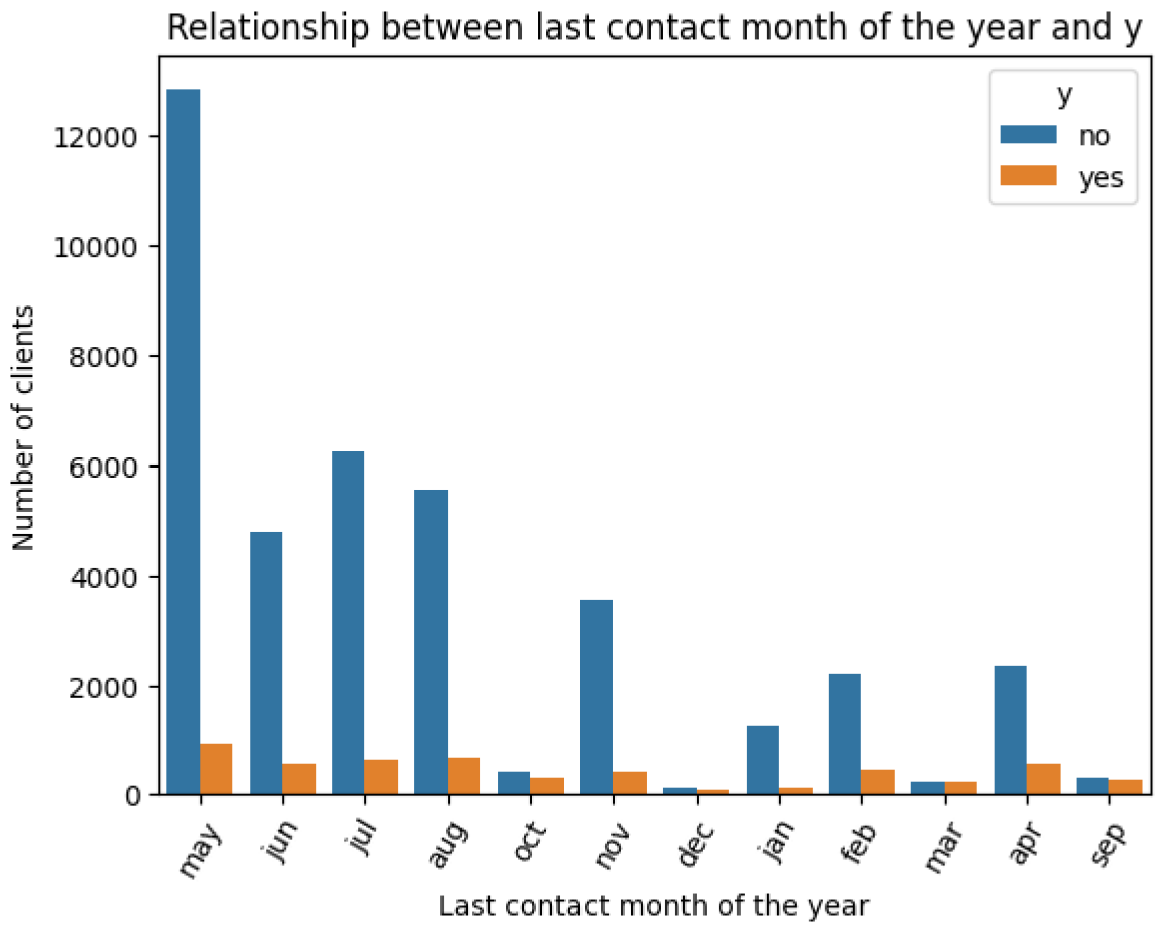
Chi-square statistic: 1037.6674151454113

P-value: 4.713937018716045e-226

Reject the null hypothesis: There is a significant association between the variables.

```
# Answer 18 : Relationship between last contact month of the year and y
sns.countplot(x='month', hue='y', data=df)
plt.title("Relationship between last contact month of the year and y")
plt.xlabel("Last contact month of the year")
plt.xticks(rotation=60)
plt.ylabel("Number of clients")
plt.show()

# Non numeric variables : job, marital, education, default, housing, loan,
contact, month, poutcome
```

```
# Applying the chi square test of independence on last contact month of the year and y
contingency_Table = pd.crosstab(df['month'], df['y'])
chi2, p, dof, expected = chi2_contingency(contingency_Table)
alpha = 0.05
print(f'Chi-square statistic: {chi2}')
print(f'P-value: {p}')
if p <= alpha:
    print("Reject the null hypothesis: There is a significant association between the variables.")
else:
    print("Fail to reject the null hypothesis: There is no significant association between the variables.")
```



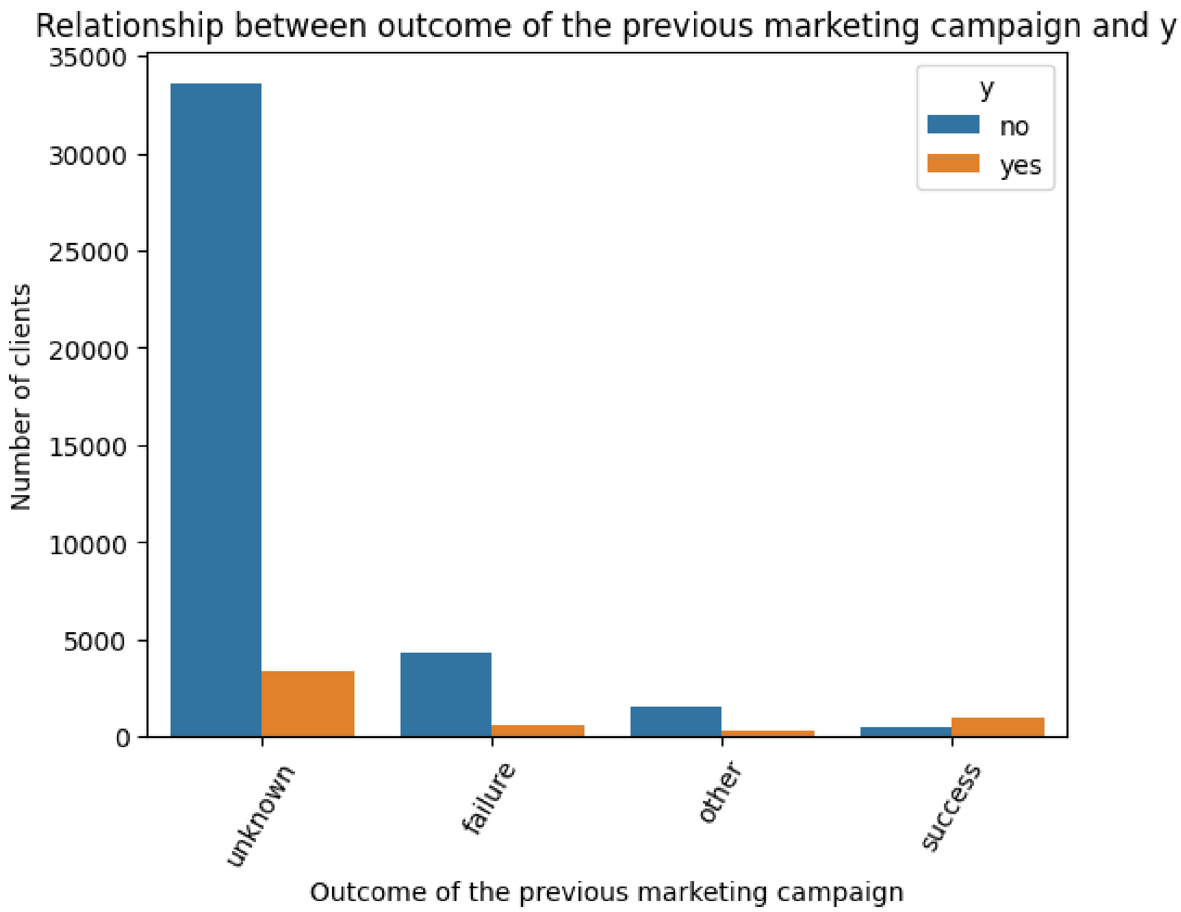
Output –

Chi-square statistic: 3058.3353989766065

P-value: 0.0

Reject the null hypothesis: There is a significant association between the variables.

```python
# Answer 18 : Relationship between outcome of the previous marketing campaign and y
sns.countplot(x='poutcome', hue='y', data=df)
plt.title("Relationship between outcome of the previous marketing campaign and y")
plt.xlabel("Outcome of the previous marketing campaign")
plt.xticks(rotation=60)
plt.ylabel("Number of clients")
plt.show()

# Non numeric variables : job, marital, education, default, housing, loan, contact, month, poutcome

# Applying the chi square test of independence on outcome of the previous marketing campaign and y
contingency_Table = pd.crosstab(df['poutcome'], df['y'])
chi2, p, dof, expected = chi2_contingency(contingency_Table)
alpha = 0.05
print(f'Chi-square statistic: {chi2}')
print(f'P-value: {p}')
if p <= alpha:
    print("Reject the null hypothesis: There is a significant association between the variables.")
else:
    print("Fail to reject the null hypothesis: There is no significant association between the variables.")
```



Output –

Chi-square statistic: 4400.2843429105305

P-value: 0.0

Reject the null hypothesis: There is a significant association between the variables.