In [ ]:

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

os.chdir('E:\WORK IN PROGRESS\Data Analytics course\parte 2 python\week 25')

# Se usa la funcion read_csv para leer el archivo . csv
# Tener en cuenta que esta vez el archivo tenia separadores el ;

df = pd.read_csv('bank-additional-full.csv',sep=';')
```

bank client data:

*1 - age (numeric)

*2 - job : type of job (categorical: "admin.","blue-collar","entrepreneur","housemaid","management","retired","self-employed","services","student","technician","unemployed","unknown")

*3 - marital : marital status (categorical: "divorced","married","single","unknown"; note: "divorced" means divorced or widowed)

*4 - education (categorical: "basic.4y","basic.6y","basic.9y","high.school","illiterate","professional.course","university.degree","unknown")

5 - default: has credit in default? (categorical: "no","yes","unknown")

6 - housing: has housing loan? (categorical: "no","yes","unknown")

7 - loan: has personal loan? (categorical: "no","yes","unknown")

related with the last contact of the current campaign:

8 - contact: contact communication type (categorical: "cellular","telephone")

*9 - month: last contact month of year (categorical: "jan", "feb", "mar", ..., "nov", "dec")

*10 - day_of_week: last contact day of the week (categorical: "mon","tue","wed","thu","fri")

*11 - duration: last contact duration, in seconds (numeric). Important note: this attribute highly affects the output target (e.g., if duration=0 then y="no"). Yet, the duration is not known before a call is performed. Also, after the end of the call y is obviously known. Thus, this input should only be included for benchmark purposes and should be discarded if the intention is to have a realistic predictive model.

other attributes:

*12 - campaign: number of contacts performed during this campaign and for this client (numeric, includes last contact)

*13 - pdays: number of days that passed by after the client was last contacted from a previous campaign (numeric; 999 means client was not previously contacted)

*14 - previous: number of contacts performed before this campaign and for this client (numeric)

1515 - poutcome: outcome of the previous marketing campaign (categorical: "failure","nonexistent","success")

social and economic context attributes

*16 - emp.var.rate: employment variation rate - quarterly indicator (numeric)

*17 - cons.price.idx: consumer price index - monthly indicator (numeric)

*18 - cons.conf.idx: consumer confidence index - monthly indicator (numeric)

*19 - euribor3m: euribor 3 month rate - daily indicator (numeric)

20 - nr.employed: number of employees - quarterly indicator (numeric)

Output variable (desired target):

21 - y - has the client subscribed a term deposit? (binary: "yes","no")

Missing Attribute Values: There are several missing values in some categorical attributes, all coded with the "unknown" label. These missing values can be treated as a possible class label or using deletion or imputation techniques.

Análisis basico

In [ ]:

```
df.sample(5)
```

Out[ ]:

	age	job	marital	education	default	housing	loan	contact	month	day_of_week	...	campaign	pdays	previous	poutcom
20181	39	technician	married	high.school	no	no	no	cellular	aug	mon	...	2	999	0	nonexister
7795	26	services	single	basic.9y	no	yes	no	telephone	jun	mon	...	3	999	0	nonexister
4678	25	services	divorced	high.school	no	yes	yes	telephone	may	wed	...	1	999	0	nonexister
28901	37	blue-collar	married	basic.4y	no	no	no	cellular	apr	fri	...	2	999	0	nonexister
25633	38	technician	married	professional.course	unknown	no	no	telephone	nov	wed	...	1	999	0	nonexister

5 rows × 21 columns

In [ ]:

```
df.shape
```

Out[ ]:

```
(41188, 21)
```

In [ ]:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 41188 entries, 0 to 41187
Data columns (total 21 columns):
 #   Column          Non-Null Count  Dtype  
---  ------          --------------  -----  
 0   age             41188 non-null  int64  
 1   job             41188 non-null  object 
 2   marital         41188 non-null  object 
 3   education       41188 non-null  object 
 4   default         41188 non-null  object 
 5   housing         41188 non-null  object 
 6   loan            41188 non-null  object 
 7   contact         41188 non-null  object 
 8   month           41188 non-null  object 
 9   day_of_week     41188 non-null  object 
 10  duration        41188 non-null  int64  
 11  campaign        41188 non-null  int64  
 12  pdays           41188 non-null  int64  
 13  previous        41188 non-null  int64  
 14  poutcome        41188 non-null  object 
 15  emp.var.rate    41188 non-null  float64
 16  cons.price.idx  41188 non-null  float64
 17  cons.conf.idx   41188 non-null  float64
 18  euribor3m       41188 non-null  float64
 19  nr.employed     41188 non-null  float64
 20  y               41188 non-null  object 
dtypes: float64(5), int64(5), object(11)
memory usage: 6.6+ MB
```

- Este dataset tiene 11 categorical variables (algunas tienen que ser transformadas) y 10 numerical variables

In [ ]:

```
pd.options.display.float_format='{:.2f}'.format
```

In [ ]:

```
df.describe().T
```

Out[ ]:

	count	mean	std	min	25%	50%	75%	max
age	41188.00	40.02	10.42	17.00	32.00	38.00	47.00	98.00
duration	41188.00	258.29	259.28	0.00	102.00	180.00	319.00	4918.00
campaign	41188.00	2.57	2.77	1.00	1.00	2.00	3.00	56.00
pdays	41188.00	962.48	186.91	0.00	999.00	999.00	999.00	999.00
previous	41188.00	0.17	0.49	0.00	0.00	0.00	0.00	7.00
emp.var.rate	41188.00	0.08	1.57	-3.40	-1.80	1.10	1.40	1.40
cons.price.idx	41188.00	93.58	0.58	92.20	93.08	93.75	93.99	94.77
cons.conf.idx	41188.00	-40.50	4.63	-50.80	-42.70	-41.80	-36.40	-26.90
euribor3m	41188.00	3.62	1.73	0.63	1.34	4.86	4.96	5.04
nr.employed	41188.00	5167.04	72.25	4963.60	5099.10	5191.00	5228.10	5228.10

In [ ]:

```
df.nunique().sort_values(ascending=False)
```

Out[ ]:

```
duration          1544
euribor3m          316
age                 78
campaign            42
pdays               27
cons.conf.idx       26
cons.price.idx      26
job                 12
nr.employed         11
month               10
emp.var.rate        10
previous             8
education            8
day_of_week          5
marital              4
default              3
poutcome             3
loan                 3
housing              3
contact              2
y                    2
dtype: int64
```

In [ ]:

```
# Validar cuantas celdas en total son nulas

print('Existen' , df.isnull().sum().sum(), ' valores no definidos')
print("Sin embargo, como se verá en el análisis univariable hay celdas unknown")
```

```
Existen 0  valores no definidos
Sin embargo, como se verá en el análisis univariable hay celdas unknown
```

In [ ]:

```
df.columns
```

Out[ ]:

```
Index(['age', 'job', 'marital', 'education', 'default', 'housing', 'loan',
       'contact', 'month', 'day_of_week', 'duration', 'campaign', 'pdays',
       'previous', 'poutcome', 'emp.var.rate', 'cons.price.idx',
       'cons.conf.idx', 'euribor3m', 'nr.employed', 'y'],
      dtype='object')
```

Análisis univariable

Dado que el dataset está dividido en 5 grupos de variables (

1. Esential bank client data,
2. Related with the last contact of the current campaign,
3. Other attributes,
4. Social and economic context attributes,
5. Output variable (desired target))

haré un análisis univariable a partir de estos grupos.

- Esential bank client data:

- Esta parte del dataset contiene 7 variables una numérica ("Age") y 6 categorical (no definidas) (job', 'marital', 'education', 'default', 'housing', 'loan').
- Se hace primero el análisis de las variables numéricas y despues el de las categoricals

Numerical variables

In [ ]:

```python
df["age"].describe().reset_index().T
```

Out[ ]:

	0	1	2	3	4	5	6	7
index	count	mean	std	min	25%	50%	75%	max
age	41188.00	40.02	10.42	17.00	32.00	38.00	47.00	98.00

In [ ]:

```python
mean_age = df['age'].mean()
median_age = df['age'].median()
mode_age=df['age'].mode()[0]
```

In [ ]:

```python
df.groupby('age')['age'].count().sort_values(ascending=False)
```

Out[ ]:

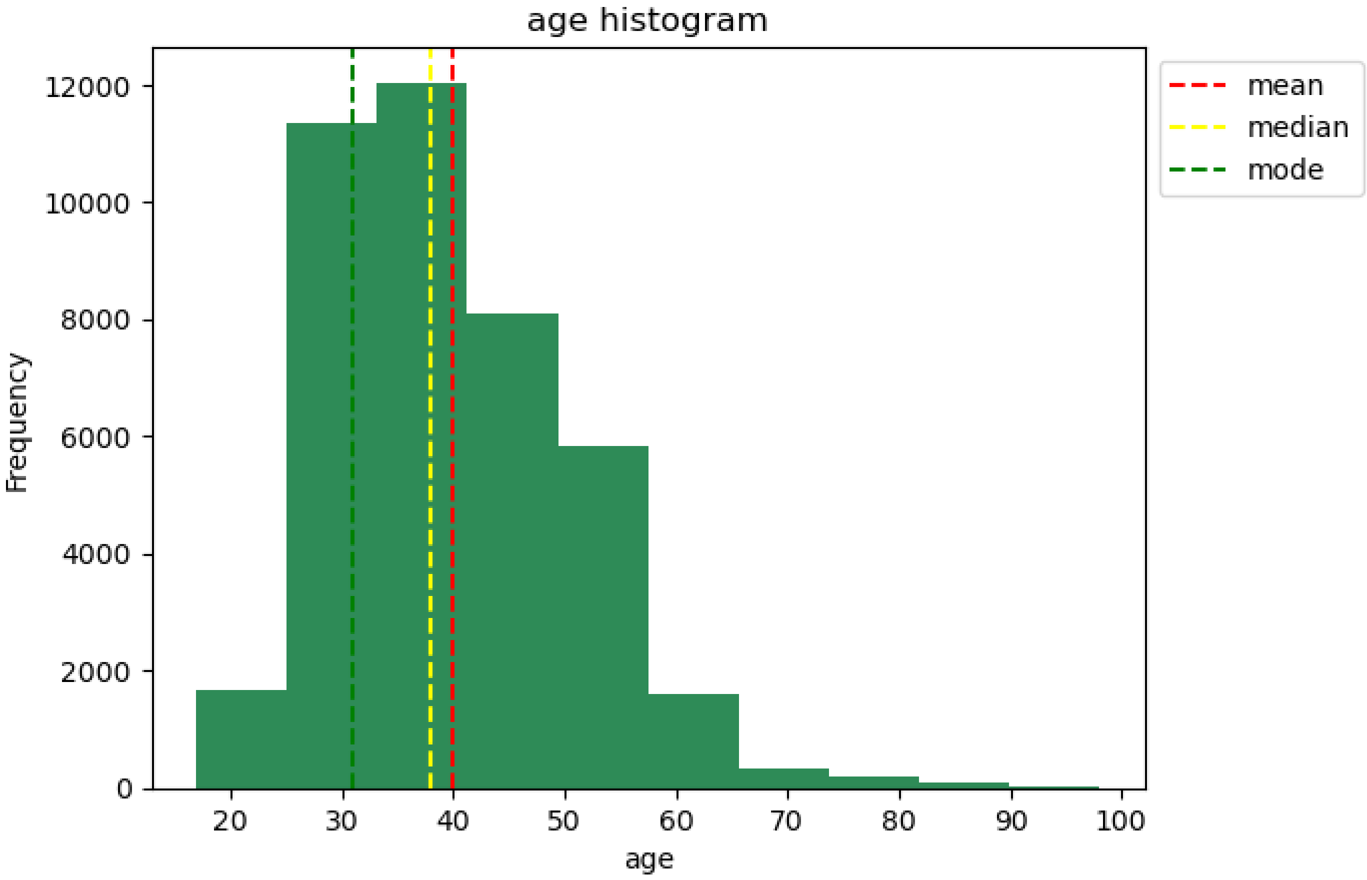
```
age
31    1947
32    1846
33    1833
36    1780
35    1759
      ...
91       2
98       2
87       1
94       1
95       1
Name: age, Length: 78, dtype: int64
```

In [ ]:

```
#df.groupby('age')['age'].count().plot.bar()
plt.hist(df['age'],color='seagreen')
plt.xlabel('age')
plt.ylabel('Frequency')
plt.title('age histogram')
plt.axvline(x=mean_age,color='red', ls='--', label='mean')
plt.axvline(x=median_age,color='yellow',ls='--',label='median')
plt.axvline(x=mode_age,color='green',ls='--',label='mode')
plt.legend(bbox_to_anchor = (1.0, 1), loc = 'upper left')
```

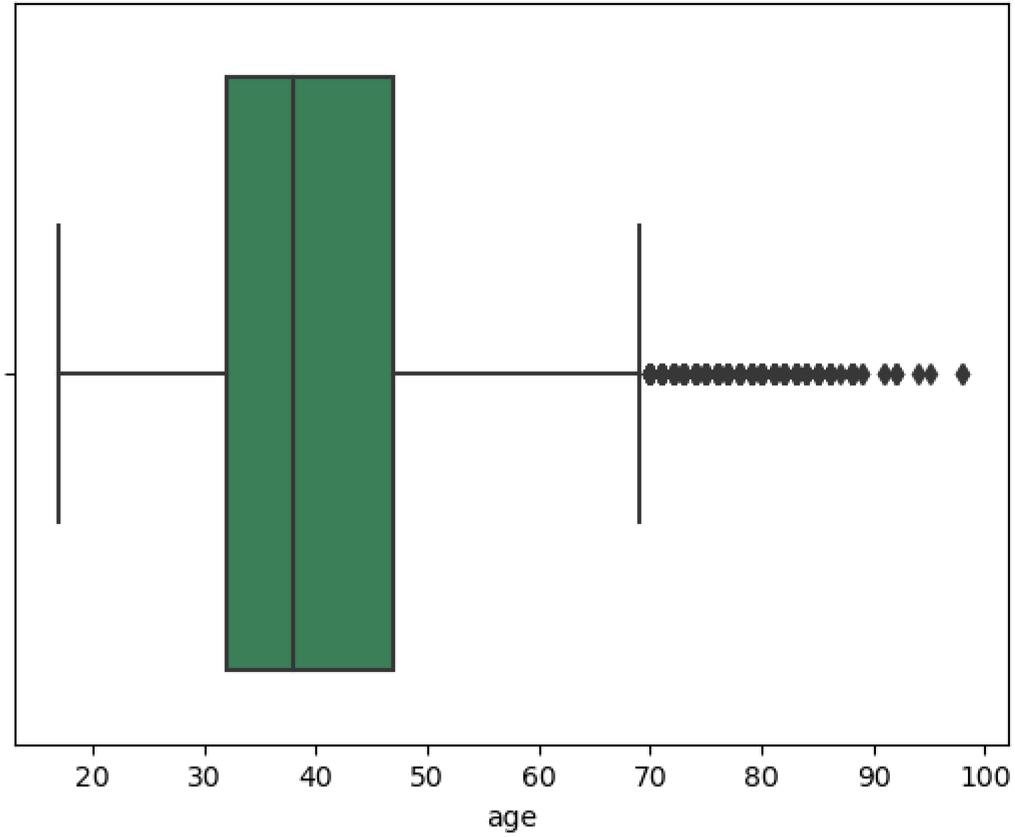
Out[ ]:

```
<matplotlib.legend.Legend at 0x2b3816c0580>
```



```
In [ ]: sns.boxplot(x=df['age'],color='seagreen')
```

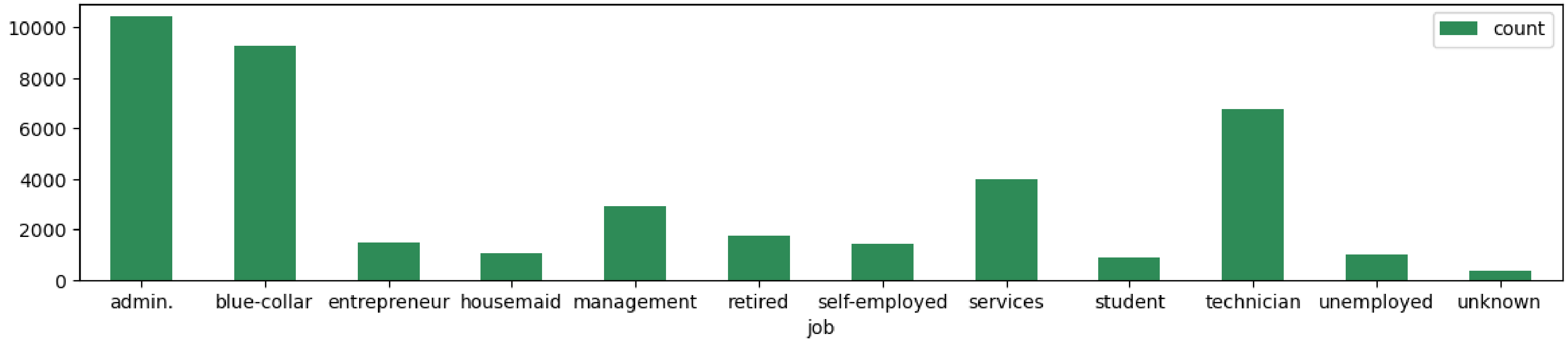
```
Out[ ]: <AxesSubplot: xlabel='age'>
```

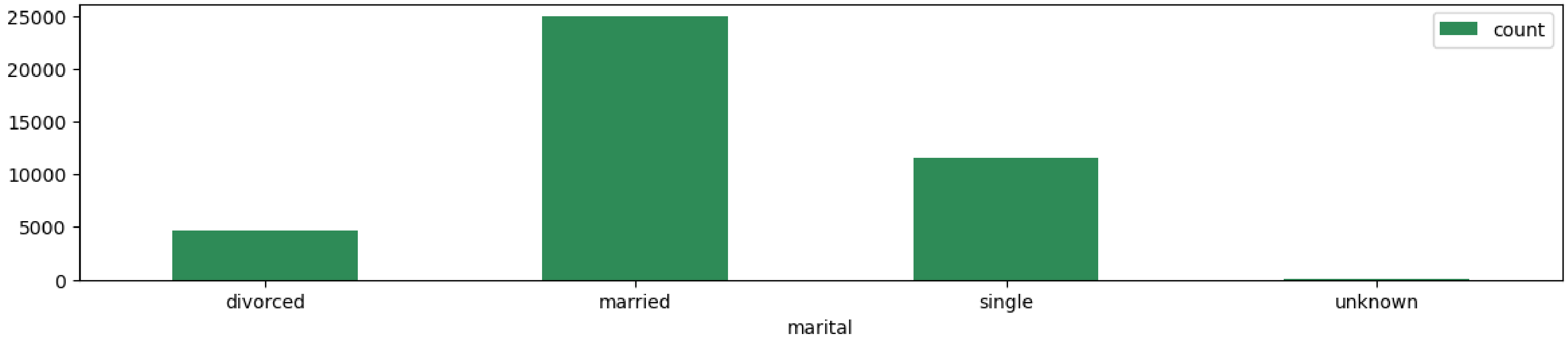


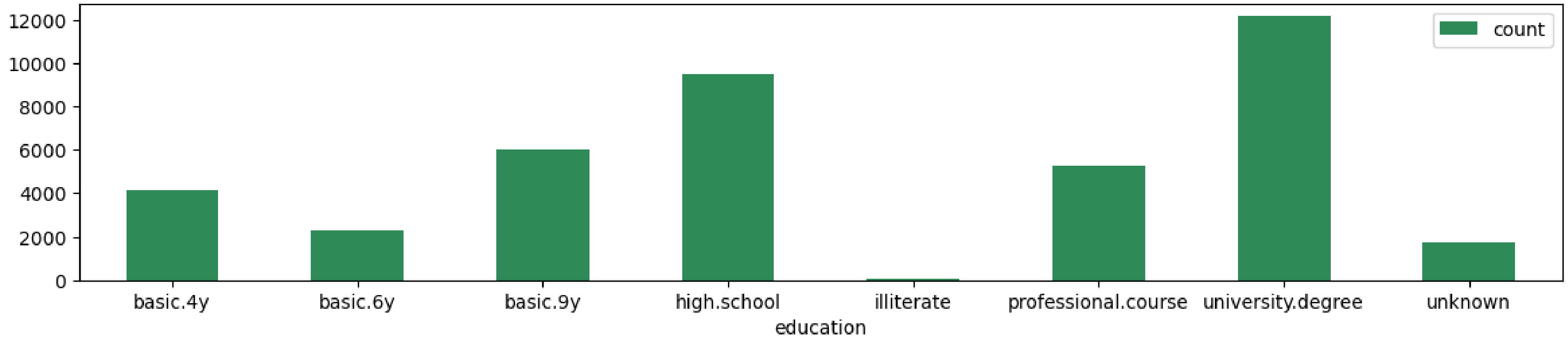
Categorical variables

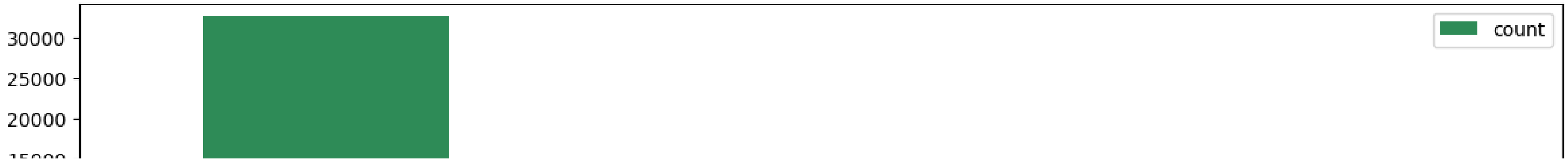
In [ ]:
```
firstsetcolumns=['job', 'marital', 'education', 'default', 'housing', 'loan']
```

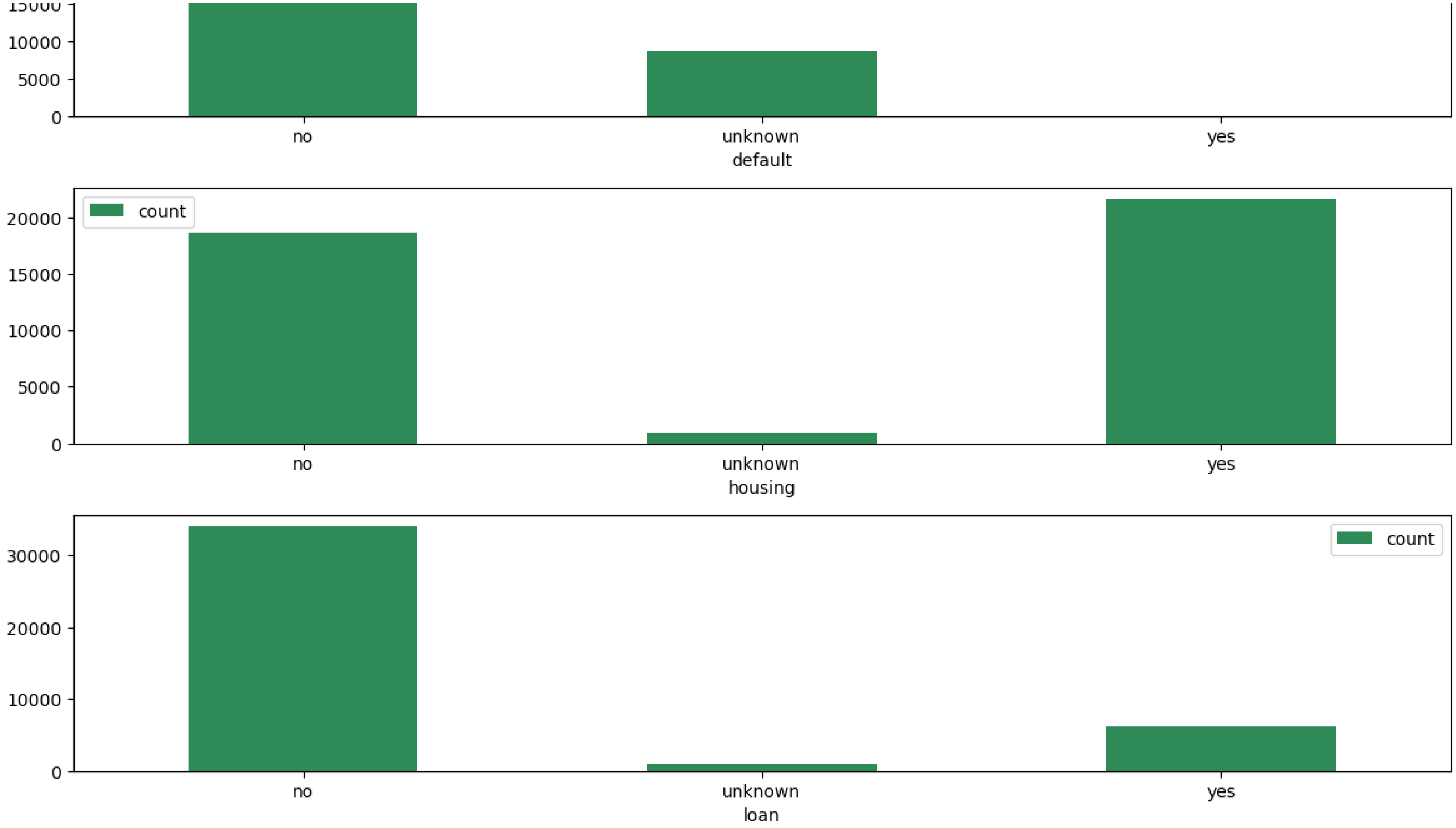
In [ ]:
```
fig, axes = plt.subplots(nrows=6,ncols=1, figsize=(12,16))
fig.tight_layout(pad=2.0)
for i, column in enumerate (firstsetcolumns):

    df_helper= df.groupby(column)[column].count().rename('count').reset_index()
    df_helper.plot.bar(x=column,ax=axes[i],color='seagreen')
    axes[i].tick_params(labelrotation=360)
```


10000
8000
6000
4000
2000
0
count
admin.
blue-collar
entrepreneur
housemaid
management
retired
self-employed
services
student
technician
unemployed
unknown
job


25000
20000
15000
10000
5000
0
count
divorced
married
single
unknown
marital


12000
10000
8000
6000
4000
2000
0
count
basic.4y
basic.6y
basic.9y
high.school
illiterate
professional.course
university.degree
unknown
education


30000
25000
20000
count



Insights

- La varialbe numérica "age" tiene un sesgo hacia la derecha. Para fines del análisis de Machine Learning se tendría que usar logaritmo para corregir ese sesgo.
- Por otro lado el histograma y el boxplot nos permiten ver que la mayor frecuencia esta concentrada en dos grupos de edad (30 y 40 años) con una dispersión mayor hacia la derecha. (los outliers no estan considerablemente lejos del límite)
- Con respecto a las variables de categoría se podría decir que:

- Un poco más de la mitad de los registros estan casados.
- Un poco menos de la mitad de los registros tienen un cargo administrativo o industrial manual work (blue-collar').
- Mas o menos la mitad de los registros han terminado el high school o tienen ya una carrera universitaria.
- La gran parte no tienen un prestamo personal ni estan reportados por credit default.
- En todas las variables de categoría se tiene como categoria "unknow" que quiere decir para esta preciso dataset valores nulos. Por lo cual se tendría que entender que hacer con esos valores.

Related with the last contact of the current campaign

- Esta parte del dataset contiene 4 variables una numérica ("duration") y 3 categorical (no definidas) ('contact', 'month', 'day_of_week').

- Se hace primero el análisis de las variables numéricas y despues el de las categoricals

Numerical variables

In [ ]:

```
df["duration"].describe().reset_index().T

# Hay que recordar que esta variable esta en segundos
```

Out[ ]:

```
                 0       1       2     3       4       5       6        7
   index     count    mean     std   min     25%     50%     75%      max
duration  41188.00  258.29  259.28  0.00  102.00  180.00  319.00  4918.00
```

In [ ]:

```
mean_duration = df['duration'].mean()
median_duration = df['duration'].median()
mode_duration=df['duration'].mode()[0]
```

In [ ]:

```
df.groupby('duration')['duration'].count().sort_values(ascending=False)
```

Out[ ]:

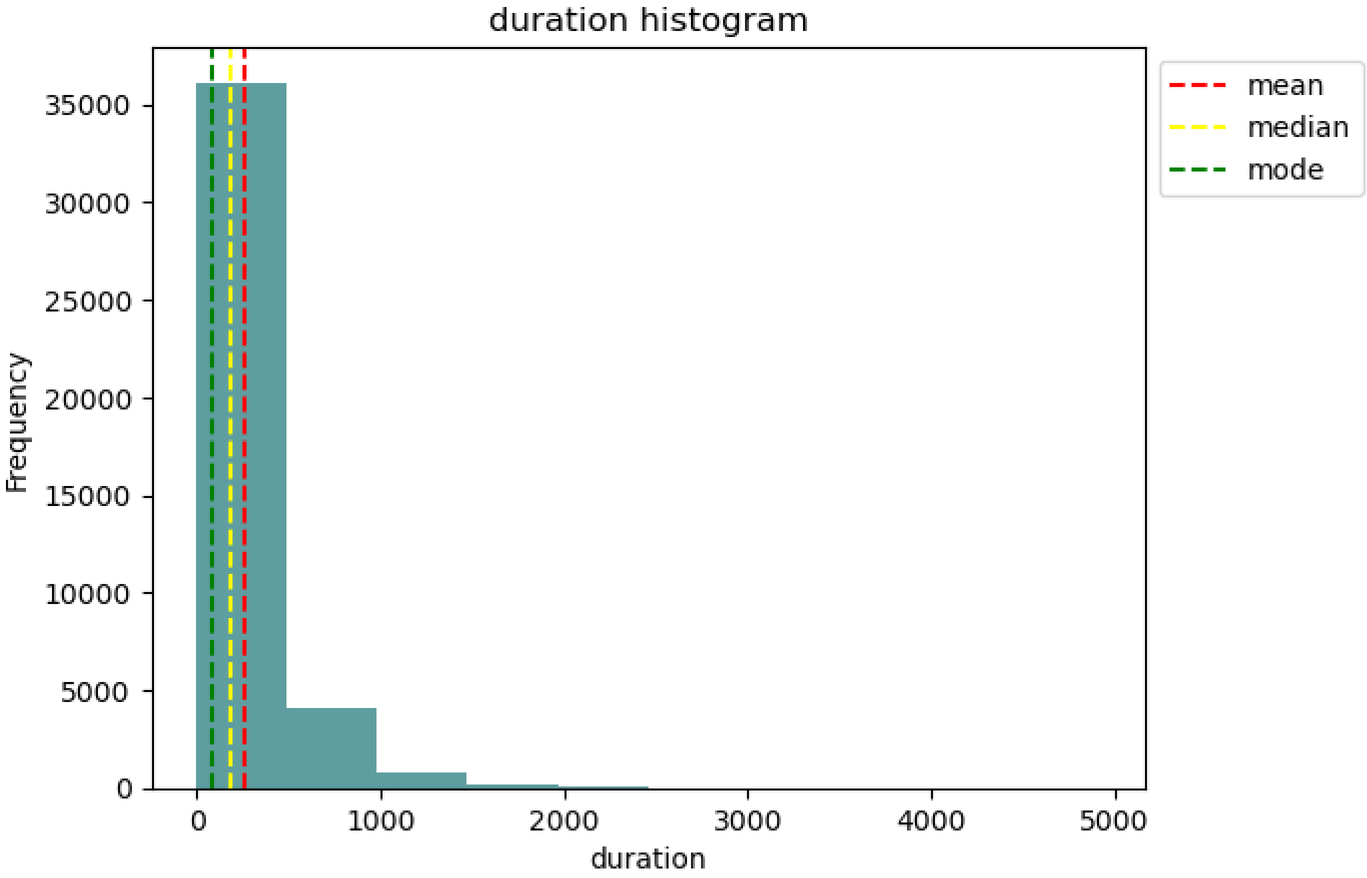
```
duration
90      170
85      170
136     168
73      167
124     164
       ...
1348      1
1347      1
1345      1
1342      1
4918      1
Name: duration, Length: 1544, dtype: int64
```

In [ ]:

```python
plt.hist(df['duration'], color="cadetblue")
plt.xlabel('duration')
plt.ylabel('Frequency')
plt.title('duration histogram')
plt.axvline(x=mean_duration,color='red', ls='--', label='mean')
plt.axvline(x=median_duration,color='yellow',ls='--',label='median')
plt.axvline(x=mode_duration,color='green',ls='--',label='mode')
plt.legend(bbox_to_anchor = (1.0, 1), loc = 'upper left')
```

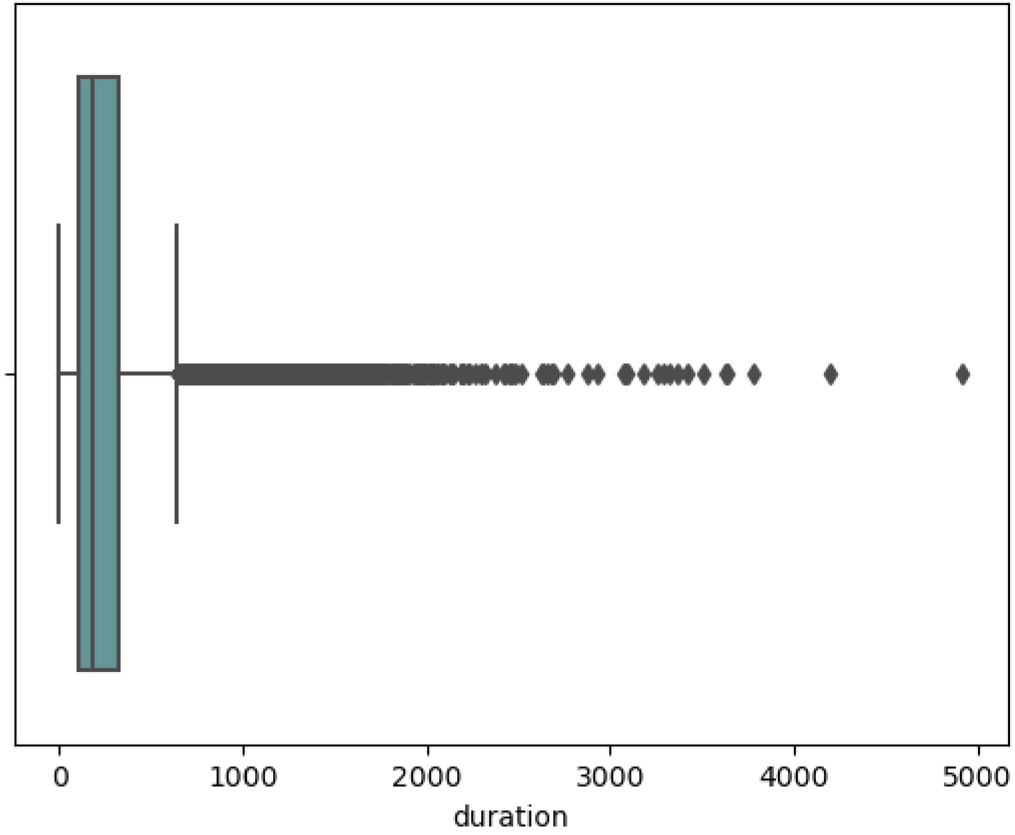
Out[ ]:

```
<matplotlib.legend.Legend at 0x2b38273bc10>
```



```
In [ ]: sns.boxplot(x=df['duration'], color="cadetblue")
```

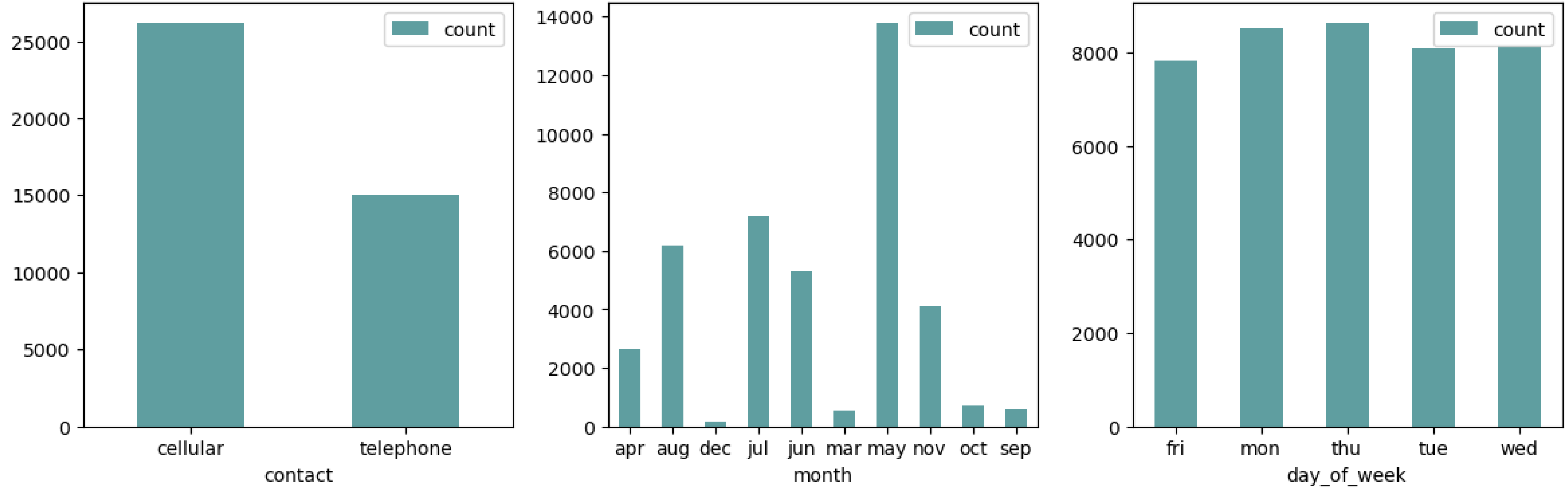
```
Out[ ]: <AxesSubplot: xlabel='duration'>
```



Categorical variables

In [ ]:
```
secondsetcolumns=['contact', 'month', 'day_of_week']
```

In [ ]:
```
fig, axes = plt.subplots(nrows=1,ncols=3, figsize=(12,4))
fig.tight_layout(pad=2.0)
for i, column in enumerate (secondsetcolumns):

    df_helper= df.groupby(column)[column].count().rename('count').reset_index()
    df_helper.plot.bar(x=column,ax=axes[i], color="cadetblue")
    axes[i].tick_params(labelrotation=360)
```



Insights

- La variable numérica "duration" tiene un sesgo muy pronunciado hacia la derecha. Para fines del análisis de Machine Learning se tendría que usar logaritmo para corregir ese sesgo.
- Por otro lado el histograma y el boxplot nos permiten ver que la mayor frecuencia esta concentrada en los primeros 5 minutos de la llamada con una dispersión mayor hacia la derecha.
- El 50% de las llamadas no dura más de 3 minutos.
- Con respecto a las variables de categoría se podría decir que:
  - Hay una preferencia por hacer las llamadas al celular (mas o menos del 60%) que al telefono.
  - La tercera parte de las llamadas de la campaña actual se hizo en el mes de mayo.
  - En febrero y marzo no hubo ningún contacto con los clientes.
  - No hay una preferencia por el día de la semana en el cual se hizo la llamada de contacto.

Con respecto a la variable "duration" es importante tener en cuenta la siguiente informacion:

```
* 11 - duration: last contact duration, in seconds (numeric). Important note: this attribute highly affects
the output target (e.g., if duration=0 then y="no"). Yet, the duration is not known before a call is
```

```
performed. Also, after the end of the call y is obviously known. Thus, this input should only be included for
benchmark purposes and should be discarded if the intention is to have a realistic predictive model.
```

Other attributes

- Esta parte del dataset contiene 4 variables: Tres numéricas ('campaign', 'pdays', 'previous') y 1 categorical (no definidas) ('poutcome').
- Se hace primero el análisis de las variables numéricas y despues el de las categoricals

Numerical variables

In [ ]:

```
thirdsetcolumns= ['campaign', 'pdays', 'previous']
```

In [ ]:

```
df[thirdsetcolumns].describe().T
```

Out[ ]:

	count	mean	std	min	25%	50%	75%	max
campaign	41188.00	2.57	2.77	1.00	1.00	2.00	3.00	56.00
pdays	41188.00	962.48	186.91	0.00	999.00	999.00	999.00	999.00
previous	41188.00	0.17	0.49	0.00	0.00	0.00	0.00	7.00

In [ ]:

```
df.groupby('campaign')['campaign'].count().sort_values(ascending=False)
```

Out[ ]:

```
campaign
1     17642
2     10570
3      5341
4      2651
5      1599
6       979
7       629
8       400
9       283
10      225
11      177
12      125
13       92
14       69
17       58
15       51
16       51
18       33
20       30
19       26
21       24
22       17
23       16
24       15
27       11
29       10
25        8
26        8
28        8
30        7
31        7
35        5
33        4
32        4
34        3
40        2
42        2
43        2
37        1
39        1
41        1
56        1
Name: campaign, dtype: int64
```

In [ ]:

```
df.groupby('pdays')['pdays'].count().sort_values(ascending=False)
```

Out[ ]:

```
pdays
999    39673
3        439
6        412
4        118
9         64
2         61
7         60
12        58
10        52
5         46
13        36
11        28
1         26
15        24
14        20
8         18
0         15
16        11
17         8
18         7
19         3
22         3
21         2
20         1
25         1
26         1
27         1
Name: pdays, dtype: int64
```

In [ ]:

```
df.groupby('previous')['previous'].count().sort_values(ascending=False)
```

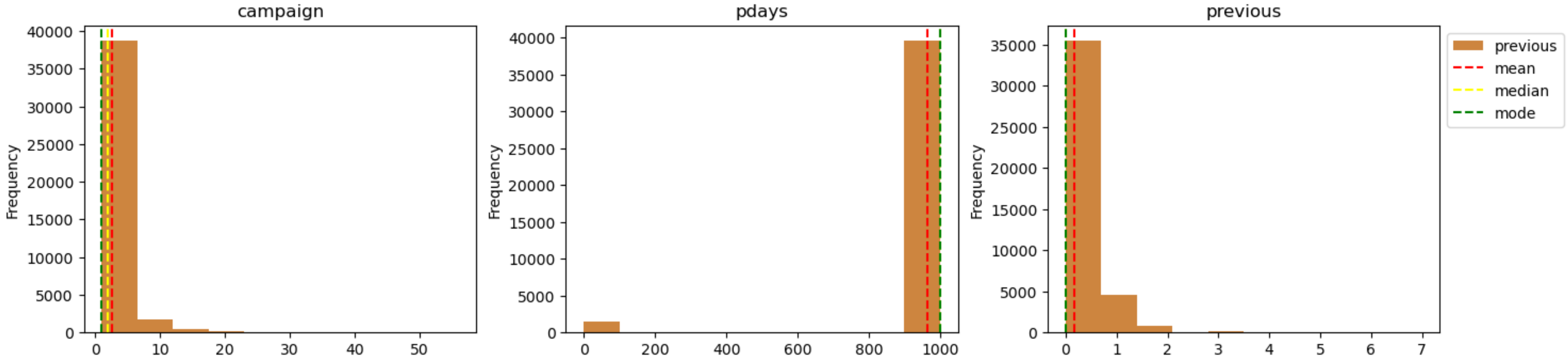
Out[ ]:

```
previous
0    35563
1     4561
2      754
3      216
4       70
5       18
6        5
7        1
Name: previous, dtype: int64
```

In [ ]:

```python
fig, axes = plt.subplots(nrows=1,ncols=3, figsize=(14,4))
fig.tight_layout(pad=3.0)
for i, column in enumerate (thirdsetcolumns):
     df[column].plot(kind='hist',ax=axes[i],color='peru')
     axes[i].axvline(x=df[column].mean(),color='red', ls='--', label='mean')
     axes[i].axvline(x=df[column].median(),color='yellow',ls='--',label='median')
     axes[i].axvline(x=df[column].mode()[0],color='green',ls='--',label='mode')
     axes[i].title.set_text(thirdsetcolumns[i])
     plt.legend(bbox_to_anchor = (1.0, 1), loc = 'upper left')
```

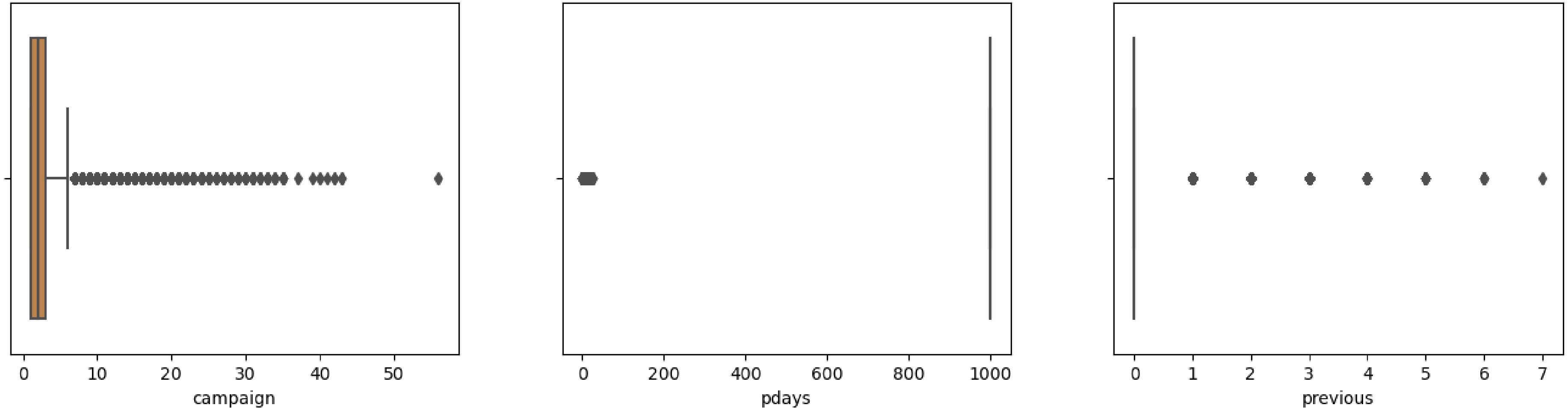
```
No artists with labels found to put in legend.  Note that artists whose label start with an underscore are ignored when legend() is called with no argument.
No artists with labels found to put in legend.  Note that artists whose label start with an underscore are ignored when legend() is called with no argument.
```



In [ ]:

```python
fig, axes = plt.subplots(nrows=1,ncols=3, figsize=(14,4))
fig.tight_layout(pad=3.0)
```

```python
for i, column in enumerate (thirdsetcolumns):
    sns.boxplot(x=df[column], color="peru",ax=axes[i])
```



Categorical variables

In [ ]:

```python
df.groupby('poutcome')['poutcome'].count()
```

Out[ ]:

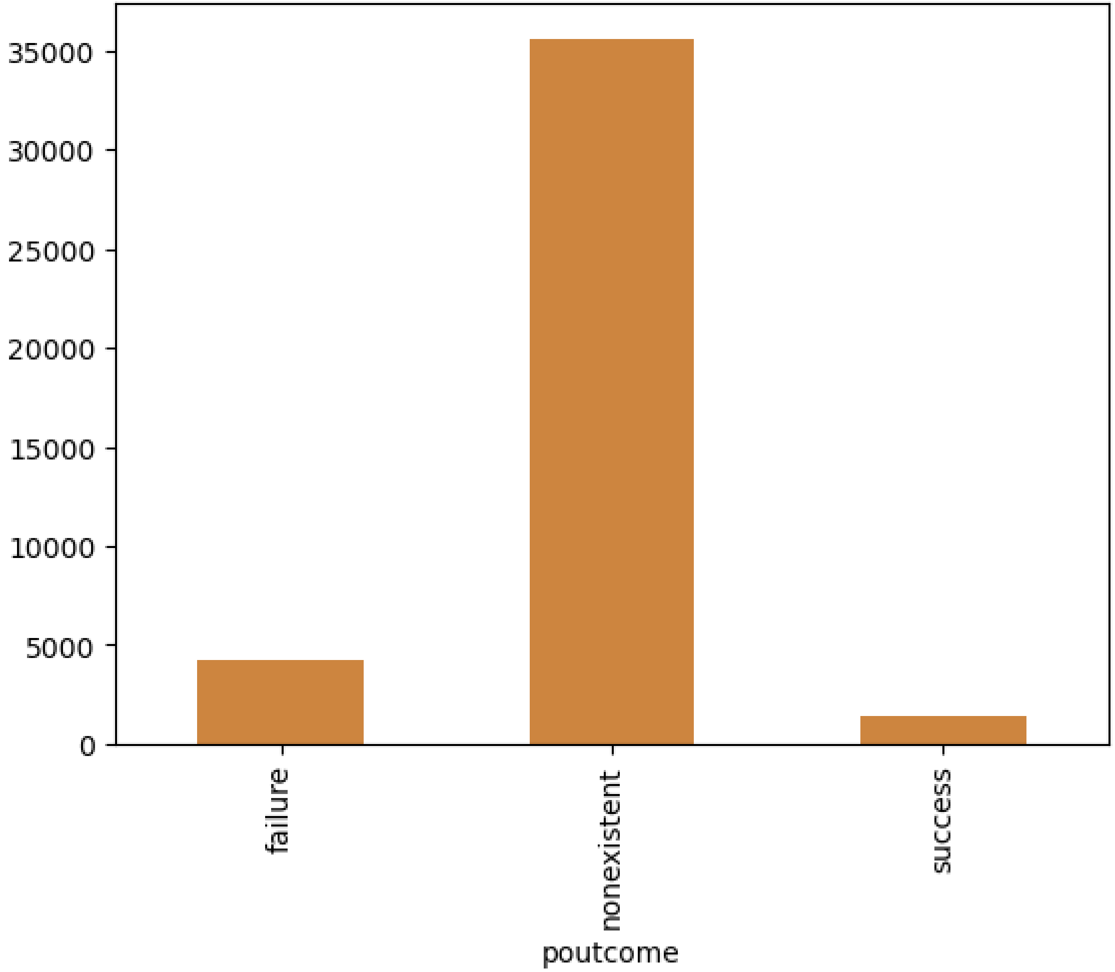
```
poutcome
failure         4252
nonexistent    35563
success         1373
Name: poutcome, dtype: int64
```

In [ ]:

```python
df.groupby('poutcome')['poutcome'].count().plot.bar(color='peru')
```

Out[ ]:

```
<AxesSubplot: xlabel='poutcome'>
```



Insights

- Las variables numericas y de categoría de esta sección del dataset no proporcionan información relevante.
  - Entre las variables numericas, "campaign" es la única que arroja información para ser considerada.
  - El 75% de las personas fue contactada en la capaña actual al menos 3 veces. Pero despues se puede observar un sesgo largo hacia la derecha. Por lo cual, si se quiere utilizar esta variable para el modelo de machine learning, se le tendría que realizar una transformación logaritmica.

- La variable "pdays" no es muy útil ya que entre 27 posibles opciones más del 95% esta concentrado en una sola opción, la cual no es ni siquiera relevante: "999" que quiere decir que el cliente no fue previamente contactado en una campaña anterior.
- La variable "previous" tiene un comportamiento muy similar a la variable "pdays", ya que más del 85% esta concentrado en una sola opción: "0" que quiere decir que el cliente no fue previamente contactado durante una campaña anterior.
- La variable de categoria "poutcome" tiene el mismo comportamiento de la variable "previous". Como el 85% de los clientes del dataset actual no fue contactado en la anterior campaña, ese mismo 85% no tiene una respuesta para esta variable.

- social and economic context attributes

- Esta parte del dataset contiene 5 variables todas numéricas ('emp.var.rate', 'cons.price.idx', `'cons.conf.idx', 'euribor3m', 'nr.employed')`

Numerical variables

```
In [ ]: fourthsetcolumns= ['emp.var.rate', 'cons.price.idx', 'cons.conf.idx', 'euribor3m', 'nr.employed']
```

```
In [ ]: df[fourthsetcolumns].describe().T
```

Out[ ]:

	count	mean	std	min	25%	50%	75%	max
emp.var.rate	41188.00	0.08	1.57	-3.40	-1.80	1.10	1.40	1.40
cons.price.idx	41188.00	93.58	0.58	92.20	93.08	93.75	93.99	94.77
cons.conf.idx	41188.00	-40.50	4.63	-50.80	-42.70	-41.80	-36.40	-26.90
euribor3m	41188.00	3.62	1.73	0.63	1.34	4.86	4.96	5.04
nr.employed	41188.00	5167.04	72.25	4963.60	5099.10	5191.00	5228.10	5228.10

```
In [ ]: df.groupby('emp.var.rate')['emp.var.rate'].count().sort_values(ascending=False)
```

Out[ ]:

```
emp.var.rate
1.40     16234
-1.80     9184
1.10      7763
-0.10     3683
-2.90     1663
-3.40     1071
-1.70      773
-1.10      635
-3.00      172
-0.20       10
Name: emp.var.rate, dtype: int64
```

In [ ]:

```
df.groupby('cons.price.idx')['cons.price.idx'].count().sort_values(ascending=False)
```

Out[ ]:

```
cons.price.idx
93.99    7763
93.92    6685
92.89    5794
93.44    5175
94.47    4374
93.20    3616
93.08    2458
92.20     770
92.96     715
92.43     447
92.65     357
94.22     311
94.20     303
92.84     282
92.38     267
93.37     264
94.03     233
94.06     229
93.88     212
94.60     204
92.47     178
93.75     174
92.71     172
94.77     128
93.80      67
92.76      10
Name: cons.price.idx, dtype: int64
```

In [ ]:

```
df.groupby('cons.conf.idx')['cons.conf.idx'].count().sort_values(ascending=False)
```

Out[ ]:

```
cons.conf.idx
-36.40    7763
-42.70    6685
-46.20    5794
-36.10    5175
-41.80    4374
-42.00    3616
-47.10    2458
-31.40     770
-40.80     715
-26.90     447
-30.10     357
-40.30     311
-37.50     303
-50.00     282
-29.80     267
-34.80     264
-38.30     233
-39.80     229
-40.00     212
-49.50     204
-33.60     178
-34.60     174
-33.00     172
-50.80     128
-40.40      67
-45.90      10
Name: cons.conf.idx, dtype: int64
```

In [ ]:

```
df.groupby('euribor3m')['euribor3m'].count().sort_values(ascending=False)
```

Out[ ]:

```
euribor3m
4.86    2868
4.96    2613
4.96    2487
4.96    1902
4.86    1210
        ...
1.05       1
1.04       1
3.49       1
3.43       1
3.85       1
Name: euribor3m, Length: 316, dtype: int64
```

In [ ]:

```
df.groupby('nr.employed')['nr.employed'].count().sort_values(ascending=False)
```

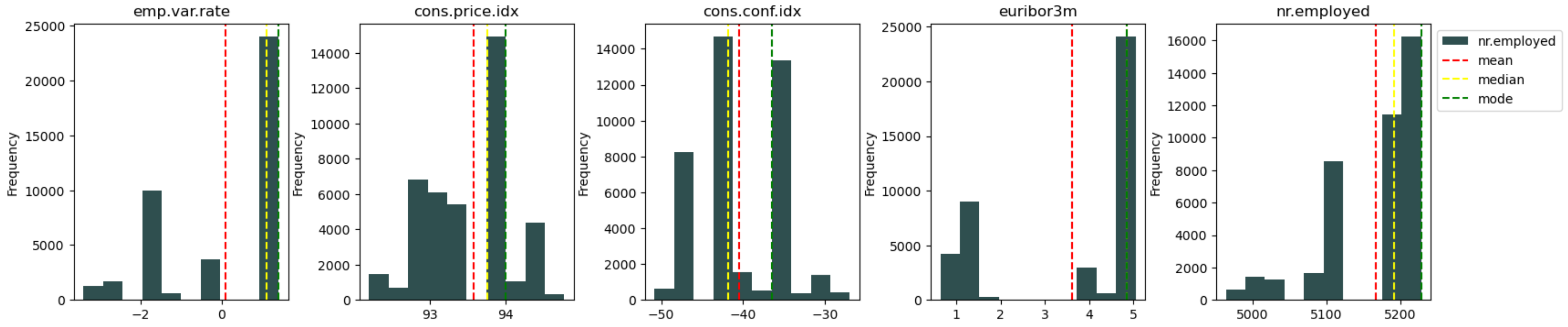
Out[ ]:

```
nr.employed
5228.10    16234
5099.10     8534
5191.00     7763
5195.80     3683
5076.20     1663
5017.50     1071
4991.60      773
5008.70      650
4963.60      635
5023.50      172
5176.30       10
Name: nr.employed, dtype: int64
```

In [ ]:

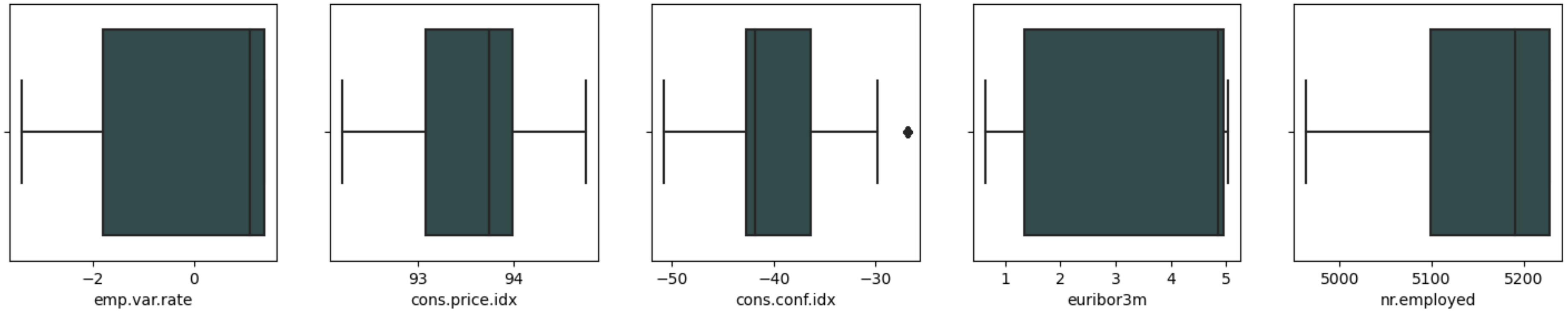
```
fig, axes = plt.subplots(nrows=1,ncols=5, figsize=(16,4))
fig.tight_layout(pad=2.5)
for i, column in enumerate (fourthsetcolumns):
     df[column].plot(kind='hist',ax=axes[i],color='darkslategrey')
     axes[i].axvline(x=df[column].mean(),color='red', ls='--', label='mean')
     axes[i].axvline(x=df[column].median(),color='yellow',ls='--',label='median')
     axes[i].axvline(x=df[column].mode()[0],color='green',ls='--',label='mode')
     axes[i].title.set_text(fourthsetcolumns[i])
     plt.legend(bbox_to_anchor = (1.0, 1), loc = 'upper left')
```

```
No artists with labels found to put in legend.  Note that artists whose label start with an underscore are ignored when legend()
is called with no argument.
No artists with labels found to put in legend.  Note that artists whose label start with an underscore are ignored when legend()
is called with no argument.
No artists with labels found to put in legend.  Note that artists whose label start with an underscore are ignored when legend()
is called with no argument.
No artists with labels found to put in legend.  Note that artists whose label start with an underscore are ignored when legend()
is called with no argument.
```



In [ ]:

```python
fig, axes = plt.subplots(nrows=1,ncols=5, figsize=(18,3))
#fig.tight_layout(pad=1.0)
for i, column in enumerate (fourthsetcolumns):
    sns.boxplot(x=df[column], color="darkslategrey",ax=axes[i])
```



Field Engineering

- Habiendo ya hecho un primer análisis univariado al dataset estas son las modificaciones que le haría:
  - Eliminar todos los datos "unkowns" de las variables 'job', 'marital', 'education', 'default', 'housing', 'loan'.
  - Cambiar el formato de las variables 'job', 'marital', 'education','contact','month','day_of_week','poutcome' de object a categorical.
  - Cambiar el formato de las variables housing, loan, y, de object a binary (int64).

Seguramente déspues de hacer la corelación tendré que considerar si realizar más cambios o no.

Eliminar todos los datos "unkowns" de las variables 'job', 'marital', 'education', 'default', 'housing', 'loan'.

In [ ]:

```
df.loc[(df['job']=='unknown') | (df['marital']=='unknown')| (df['education']=='unknown') | (df['housing']=='unknown')| (df['loan
#(df['default']=='unknown')|
```

Out[ ]:

	age	job	marital	education	default	housing	loan	contact	month	day_of_week	...	campaign	pdays	previous	poutco
7	41	blue-collar	married	unknown	unknown	no	no	telephone	may	mon	...	1	999	0	nonexist
10	41	blue-collar	married	unknown	unknown	no	no	telephone	may	mon	...	1	999	0	nonexist
26	59	technician	married	unknown	no	yes	no	telephone	may	mon	...	1	999	0	nonexist
29	55	unknown	married	university.degree	unknown	unknown	unknown	telephone	may	mon	...	1	999	0	nonexist
30	46	admin.	married	unknown	no	no	no	telephone	may	mon	...	1	999	0	nonexist
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
41118	34	technician	married	unknown	no	yes	no	cellular	nov	tue	...	2	999	2	fail
41120	60	admin.	married	unknown	no	no	no	cellular	nov	tue	...	2	999	0	nonexist
41122	34	technician	married	unknown	no	no	no	cellular	nov	tue	...	3	999	0	nonexist
41135	54	technician	married	unknown	no	yes	no	cellular	nov	thu	...	1	999	1	fail
41175	34	student	single	unknown	no	yes	no	cellular	nov	thu	...	1	999	2	fail

2943 rows × 21 columns

In [ ]:

```
default_unknown= df.loc[df['default']=='unknown']['default'].count()
default_unknown
```

Out[ ]:

```
8597
```

In [ ]:

```
total_unknown = df.loc[(df['job']=='unknown') | (df['marital']=='unknown')| (df['education']=='unknown')| (df['housing']=='unknow
total_unknown
```

Out[ ]:

```
2943
```

In [ ]:

```
# Cuantos datos totales tenemos, y cuantos missing
total_rows = df.shape[0]
# Calculo del porcentaje
percent_missing = (total_unknown/total_rows)*100
```

```
print(f' % de filas a ser eliminadas: {percent_missing:.2f} % sin tener en cuenta los valores nulos de la variable default')
print(f'ya que solo los valores nulos de esa variable equivalen al {(default_unknown/total_rows)*100:.2f}% ')
```

```
 % de filas a ser eliminadas: 7.15 % sin tener en cuenta los valores nulos de la variable default
ya que solo los valores nulos de esa variable equivalen al 20.87%
```

In [ ]:

```
df1 = df.loc[(df['job']!='unknown') & (df['marital']!='unknown')& (df['education']!='unknown')& (df['housing']!='unknown')& (df[
df1
# Ahora usare df1 para realizar las siguientes transformaciones.
# Recordar que no se eliminaron los valores nulos de la variable "default"
# ya que en termino de columnas equivalian al 21% del total de las columnas.
```

Out[ ]:

	age	job	marital	education	default	housing	loan	contact	month	day_of_week	...	campaign	pdays	previous	poutcom
0	56	housemaid	married	basic.4y	no	no	no	telephone	may	mon	...	1	999	0	nonexister
1	57	services	married	high.school	unknown	no	no	telephone	may	mon	...	1	999	0	nonexister
2	37	services	married	high.school	no	yes	no	telephone	may	mon	...	1	999	0	nonexister
3	40	admin.	married	basic.6y	no	no	no	telephone	may	mon	...	1	999	0	nonexister
4	56	services	married	high.school	no	no	yes	telephone	may	mon	...	1	999	0	nonexister
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.
41183	73	retired	married	professional.course	no	yes	no	cellular	nov	fri	...	1	999	0	nonexister
41184	46	blue-collar	married	professional.course	no	no	no	cellular	nov	fri	...	1	999	0	nonexister
41185	56	retired	married	university.degree	no	yes	no	cellular	nov	fri	...	2	999	0	nonexister
41186	44	technician	married	professional.course	no	no	no	cellular	nov	fri	...	1	999	0	nonexister
41187	74	retired	married	professional.course	no	yes	no	cellular	nov	fri	...	3	999	1	failur

38245 rows × 21 columns

In [ ]:

```
total_unknown = df1.loc[(df1['job']=='unknown') | (df1['marital']=='unknown')| (df1['education']=='unknown')| (df1['housing']=='u
total_unknown
```

Out[ ]:

```
0
```

Cambiar el formato de las variables 'job', 'marital', 'education','contact','month','day_of_week','poutcome' de object a categorical.

In [ ]:

```
df1['job']= df1['job'].astype('category')
df1['marital']= df1['marital'].astype('category')
df1['education']= df1['education'].astype('category')
df1['contact']= df1['contact'].astype('category')
df1['month']= df1['month'].astype('category')
df1['day_of_week']= df1['day_of_week'].astype('category')
df1['poutcome']= df1['poutcome'].astype('category')
```

```
C:\Users\oscah\AppData\Local\Temp\ipykernel_8532\33159217.py:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-ver
sus-a-copy
  df1['job']= df1['job'].astype('category')
C:\Users\oscah\AppData\Local\Temp\ipykernel_8532\33159217.py:2: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-ver
sus-a-copy
  df1['marital']= df1['marital'].astype('category')
C:\Users\oscah\AppData\Local\Temp\ipykernel_8532\33159217.py:3: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-ver
sus-a-copy
  df1['education']= df1['education'].astype('category')
C:\Users\oscah\AppData\Local\Temp\ipykernel_8532\33159217.py:4: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-ver
sus-a-copy
  df1['contact']= df1['contact'].astype('category')
C:\Users\oscah\AppData\Local\Temp\ipykernel_8532\33159217.py:5: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-ver
sus-a-copy
  df1['month']= df1['month'].astype('category')
C:\Users\oscah\AppData\Local\Temp\ipykernel_8532\33159217.py:6: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-ver
sus-a-copy
  df1['day_of_week']= df1['day_of_week'].astype('category')
C:\Users\oscah\AppData\Local\Temp\ipykernel_8532\33159217.py:7: SettingWithCopyWarning:
```

```
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-ver
sus-a-copy
  df1['poutcome']= df1['poutcome'].astype('category')
C:\Users\oscah\AppData\Local\Temp\ipykernel_8532\33159217.py:7: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-ver
sus-a-copy
  df1['poutcome']= df1['poutcome'].astype('category')
```

In [ ]:

```
df1.dtypes
```

Out[ ]:

```
age                  int64
job               category
marital           category
education         category
default             object
housing             object
loan                object
contact           category
month             category
day_of_week       category
duration             int64
campaign             int64
pdays                int64
previous             int64
poutcome          category
emp.var.rate       float64
cons.price.idx     float64
cons.conf.idx      float64
euribor3m          float64
nr.employed        float64
y                   object
dtype: object
```

Cambiar el formato de las variables housing, loan, y, de object a binary (int64).

In [ ]:

```
df1.sample(5)
```

Out[ ]:

	age	job	marital	education	default	housing	loan	contact	month	day_of_week	...	campaign	pdays	previous	poutcome	emp.va
10878	56	retired	married	high.school	unknown	yes	no	telephone	jun	wed	...	1	999	0	nonexistent	
12059	58	services	married	high.school	no	no	no	telephone	jun	fri	...	1	999	0	nonexistent	
31100	27	services	married	high.school	no	yes	no	cellular	may	wed	...	1	999	1	failure	
28517	45	blue-collar	married	basic.9y	unknown	yes	no	cellular	apr	tue	...	4	999	0	nonexistent	
22002	53	admin.	married	high.school	no	no	no	cellular	aug	wed	...	1	999	0	nonexistent	

5 rows × 21 columns

In [ ]:

```
df1.loc[df1["housing"] == "no", "housing"] = 0
df1.loc[df1["housing"] == "yes", "housing"] = 1
df1.loc[df1["loan"] == "no", "loan"] = 0
df1.loc[df1["loan"] == "yes", "loan"] = 1
df1.loc[df1["y"] == "no", "y"] = 0
df1.loc[df1["y"] == "yes", "y"] = 1
```

In [ ]:

```
df1['housing']= df1['housing'].astype('int64')
df1['loan']= df1['loan'].astype('int64')
df1['y']= df1['y'].astype('int64')
```

```
C:\Users\oscah\AppData\Local\Temp\ipykernel_8532\1935625931.py:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-ver
sus-a-copy
  df1['housing']= df1['housing'].astype('int64')
C:\Users\oscah\AppData\Local\Temp\ipykernel_8532\1935625931.py:2: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-ver
sus-a-copy
  df1['loan']= df1['loan'].astype('int64')
C:\Users\oscah\AppData\Local\Temp\ipykernel_8532\1935625931.py:3: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-ver
sus-a-copy
  df1['y']= df1['y'].astype('int64')
```

In [ ]:

```
df1.dtypes
```

Out[ ]:

```
age                  int64
job               category
marital           category
education         category
default             object
housing              int64
loan                 int64
contact           category
month             category
day_of_week       category
duration             int64
campaign             int64
pdays                int64
previous             int64
poutcome          category
emp.var.rate       float64
cons.price.idx     float64
cons.conf.idx      float64
euribor3m          float64
nr.employed        float64
y                    int64
dtype: object
```

Insights

- La única variable que no fue cambiada fue default ya que tiene muchos valores nulos.
- Ahora se procede a realizar la correlación

Correlación y heat map

In [ ]:

```
df1.corr('pearson').style.background_gradient(cmap='Greens')
```

```
C:\Users\oscah\AppData\Local\Temp\ipykernel_8532\2244973319.py:1: FutureWarning: The default value of numeric_only in DataFrame.
corr is deprecated. In a future version, it will default to False. Select only valid columns or specify the value of numeric_onl
y to silence this warning.
  df1.corr('pearson').style.background_gradient(cmap='Greens')
```

Out[ ]:

	age	housing	loan	duration	campaign	pdays	previous	emp.var.rate	cons.price.idx	cons.conf.idx	euribor3m	nr.empl
age	1.000000	0.000291	-0.006390	0.002405	0.005519	-0.038476	0.028479	-0.003563	-0.001236	0.127644	0.007695	-0.02
housing	0.000291	1.000000	0.045077	-0.009104	-0.010817	-0.009370	0.020837	-0.060675	-0.080849	-0.034437	-0.059595	-0.04
loan	-0.006390	0.045077	1.000000	0.000280	0.003914	0.001874	-0.003268	0.002336	-0.003146	-0.012992	0.000317	0.00
duration	0.002405	-0.009104	0.000280	1.000000	-0.071110	-0.044278	0.016304	-0.025003	0.007530	-0.008656	-0.029029	-0.04
campaign	0.005519	-0.010817	0.003914	-0.071110	1.000000	0.051536	-0.078478	0.150752	0.128665	-0.010713	0.134783	0.14
pdays	-0.038476	-0.009370	0.001874	-0.044278	0.051536	1.000000	-0.581303	0.268705	0.080828	-0.090587	0.291953	0.36
previous	0.028479	0.020837	-0.003268	0.016304	-0.078478	-0.581303	1.000000	-0.419647	-0.208783	-0.056856	-0.450672	-0.49
emp.var.rate	-0.003563	-0.060675	0.002336	-0.025003	0.150752	0.268705	-0.419647	1.000000	0.775418	0.211865	0.972422	0.90
cons.price.idx	-0.001236	-0.080849	-0.003146	0.007530	0.128665	0.080828	-0.208783	0.775418	1.000000	0.070521	0.689600	0.52
cons.conf.idx	0.127644	-0.034437	-0.012992	-0.008656	-0.010713	-0.090587	-0.056856	0.211865	0.070521	1.000000	0.292641	0.11
euribor3m	0.007695	-0.059595	0.000317	-0.029029	0.134783	0.291953	-0.450672	0.972422	0.689600	0.292641	1.000000	0.94
nr.employed	-0.021054	-0.046513	0.004088	-0.040722	0.143150	0.366783	-0.494617	0.907920	0.524272	0.115583	0.945336	1.00

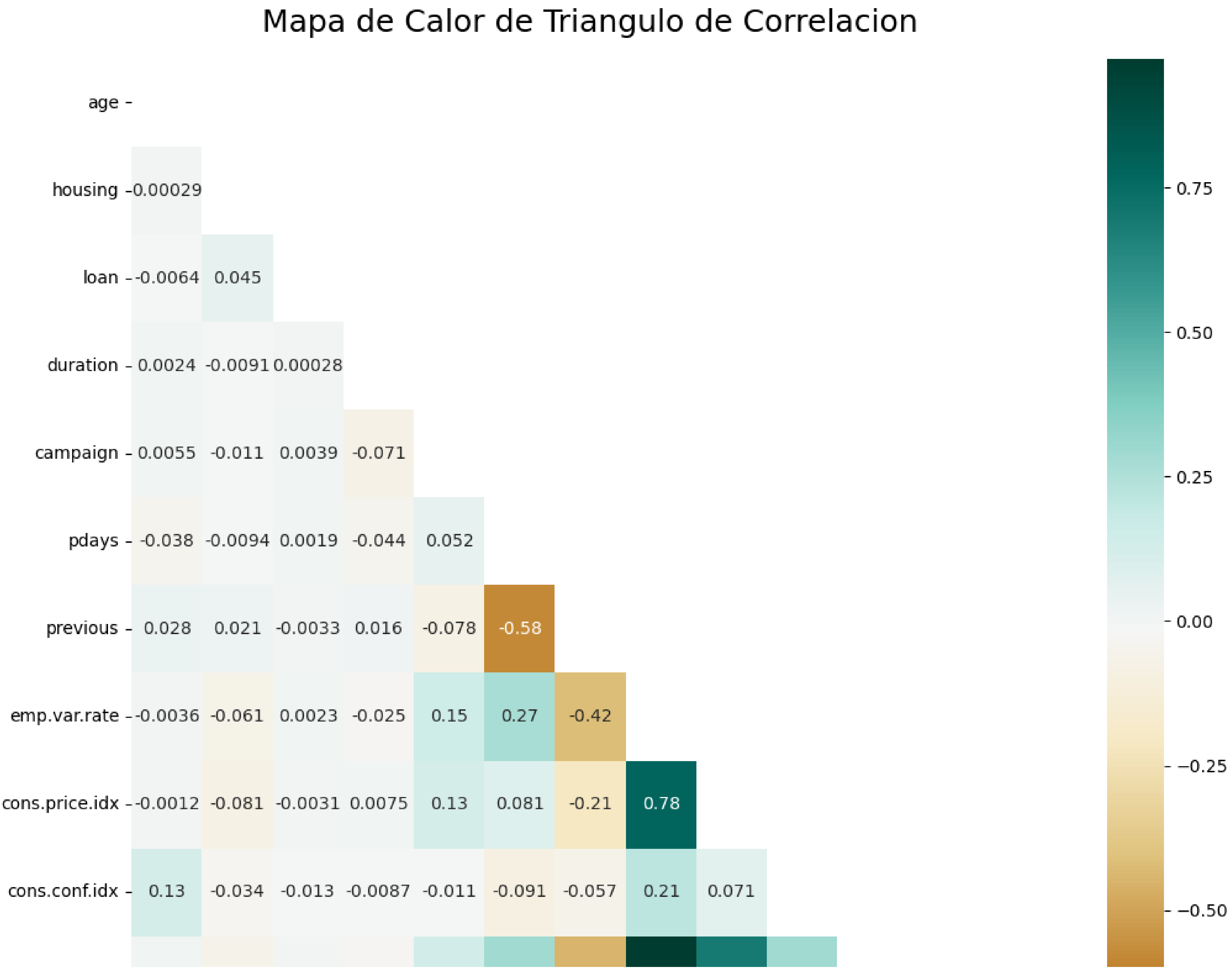
In [ ]:

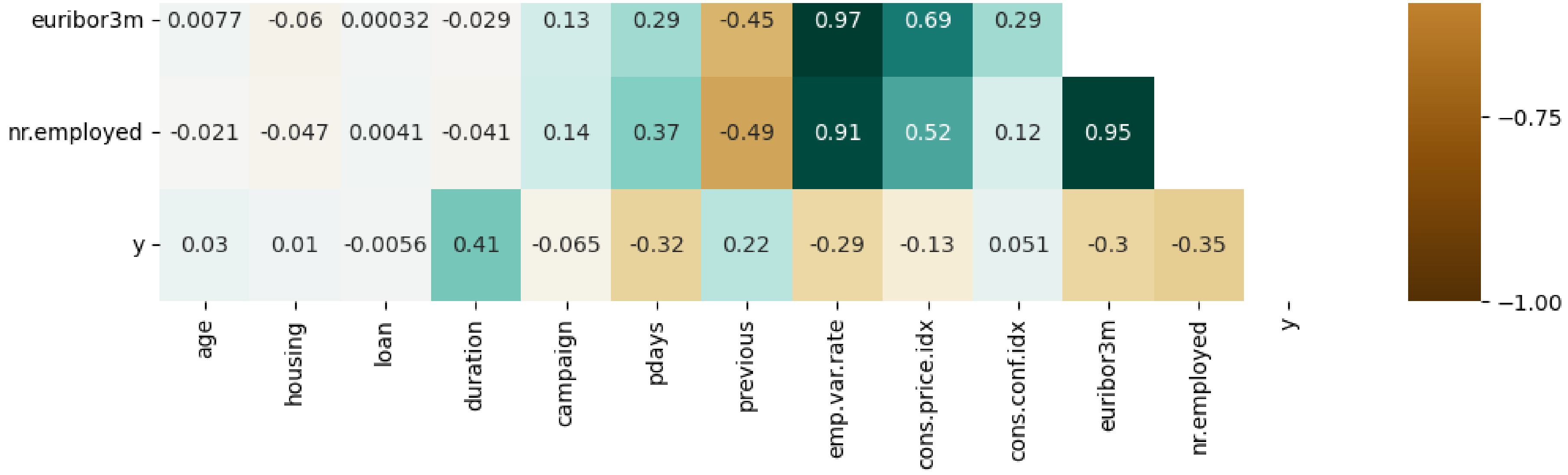
```
plt.figure(figsize=(12,12))
mask=np.triu(np.ones_like(df1.corr(),dtype=bool))
heatmap=sns.heatmap(df1.corr(),mask=mask, vmin=-1,annot=True,cmap='BrBG')
heatmap.set_title('Mapa de Calor de Triangulo de Correlacion', fontdict={'fontsize':18},pad=16)
```

```
C:\Users\oscah\AppData\Local\Temp\ipykernel_8532\3742943591.py:2: FutureWarning: The default value of numeric_only in DataFrame.
corr is deprecated. In a future version, it will default to False. Select only valid columns or specify the value of numeric_onl
y to silence this warning.
  mask=np.triu(np.ones_like(df1.corr(),dtype=bool))
C:\Users\oscah\AppData\Local\Temp\ipykernel_8532\3742943591.py:3: FutureWarning: The default value of numeric_only in DataFrame.
corr is deprecated. In a future version, it will default to False. Select only valid columns or specify the value of numeric_onl
y to silence this warning.
  heatmap=sns.heatmap(df1.corr(),mask=mask, vmin=-1,annot=True,cmap='BrBG')
```

Out[ ]:

```
Text(0.5, 1.0, 'Mapa de Calor de Triangulo de Correlacion')
```


Mapa de Calor de Triangulo de Correlacion
age -
housing -0.00029
loan -0.0064 0.045
duration 0.0024 -0.0091 0.00028
campaign 0.0055 -0.011 0.0039 -0.071
pdays -0.038 -0.0094 0.0019 -0.044 0.052
previous 0.028 0.021 -0.0033 0.016 -0.078 -0.58
emp.var.rate -0.0036 -0.061 0.0023 -0.025 0.15 0.27 -0.42
cons.price.idx -0.0012 -0.081 -0.0031 0.0075 0.13 0.081 -0.21 0.78
cons.conf.idx 0.13 -0.034 -0.013 -0.0087 -0.011 -0.091 -0.057 0.21 0.071
0.75
0.50
0.25
0.00
−0.25
−0.50



In [ ]:

```
# Dado que existe multicolinearidad entre algunas variables independientes,
# las elimino para ver como se comporta el modelo sin ellas.
```

In [ ]:

```
df2=df1.drop(['emp.var.rate','euribor3m'],axis=1)
df2.sample(5)
```

Out[ ]:

	age	job	marital	education	default	housing	loan	contact	month	day_of_week	duration	campaign	pdays	previous	p
8324	49	management	divorced	university.degree	unknown	1	0	telephone	jun	tue	165	3	999	0	nc
26125	31	entrepreneur	married	university.degree	no	0	0	telephone	nov	wed	723	2	999	0	nc
17279	54	admin.	married	university.degree	unknown	0	0	cellular	jul	fri	67	3	999	0	nc
8503	58	admin.	single	university.degree	no	0	1	telephone	jun	wed	111	3	999	0	nc
31716	47	management	married	university.degree	unknown	1	0	cellular	may	thu	72	1	999	0	nc

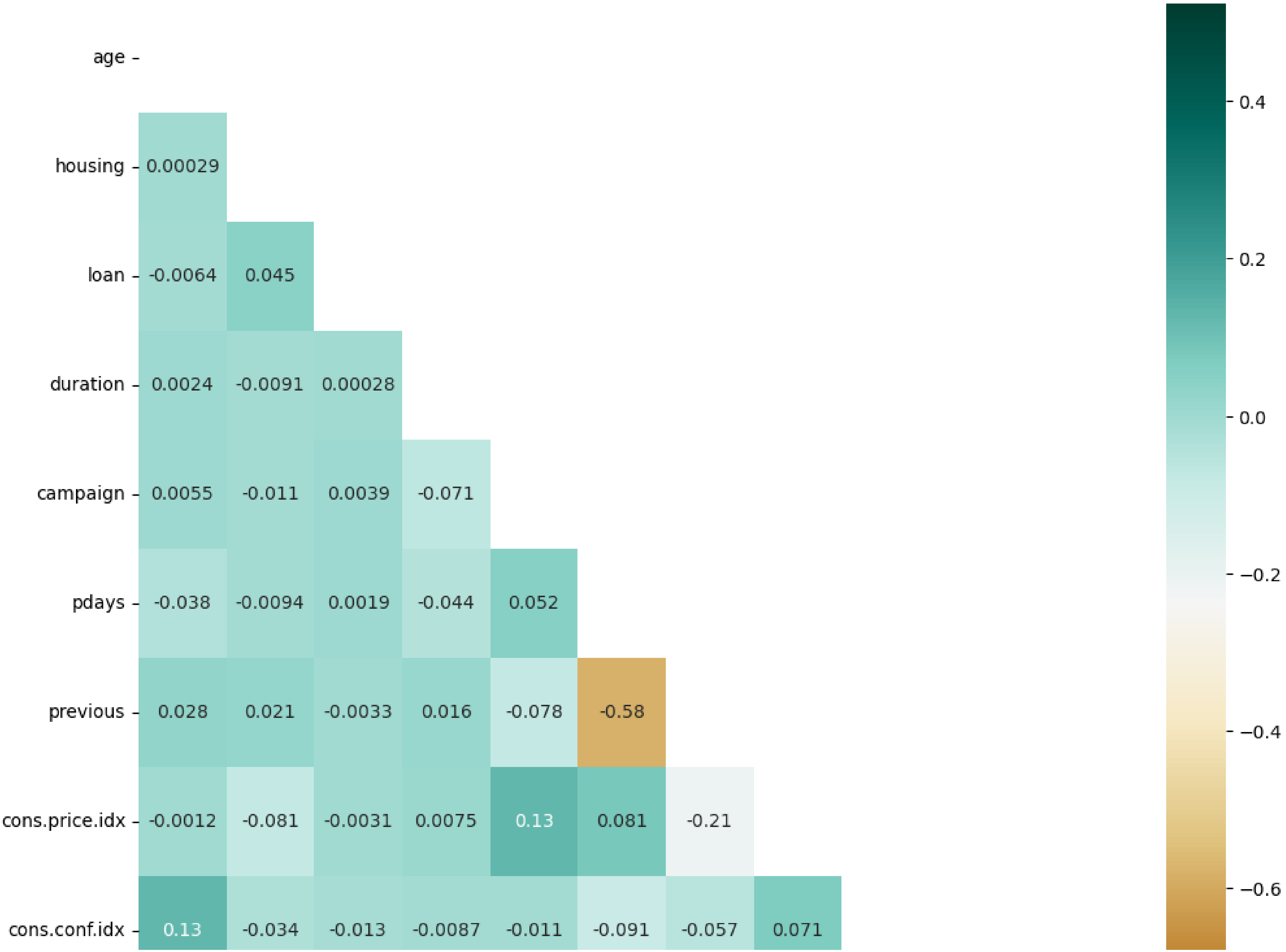
In [ ]:

```
plt.figure(figsize=(12,12))
mask=np.triu(np.ones_like(df2.corr(),dtype=bool))
heatmap=sns.heatmap(df2.corr(),mask=mask, vmin=-1,annot=True,cmap='BrBG')
heatmap.set_title('Mapa de Calor de Triangulo de Correlacion', fontdict={'fontsize':18},pad=16)
```

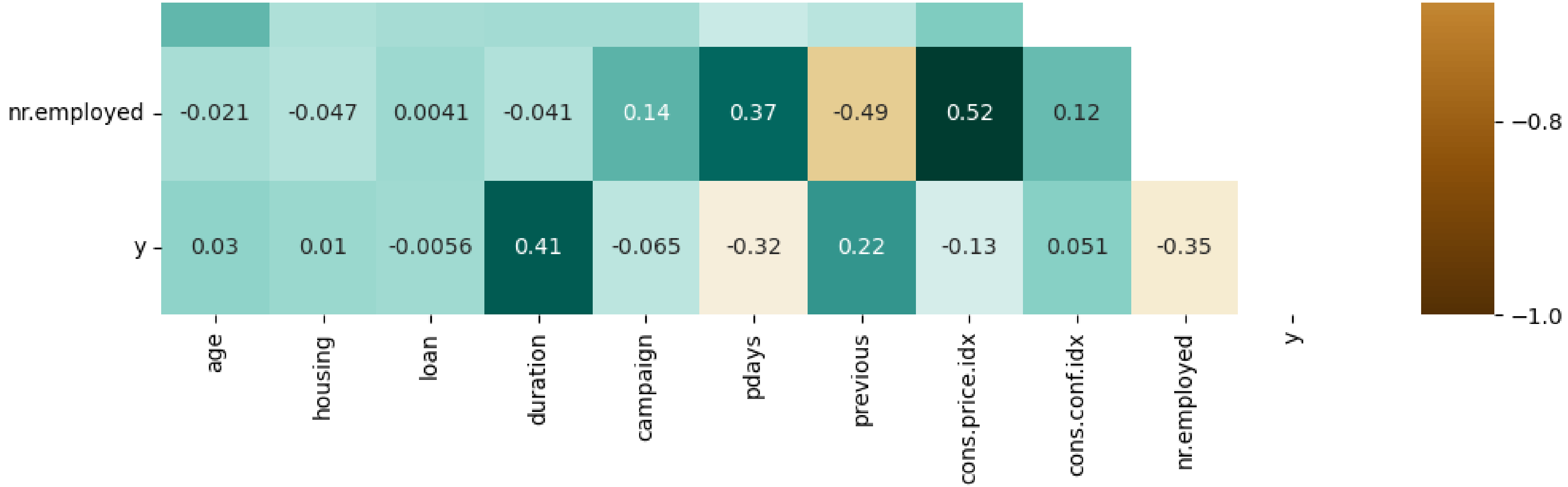
```
C:\Users\oscah\AppData\Local\Temp\ipykernel_8532\3122278506.py:2: FutureWarning: The default value of numeric_only in DataFrame.
corr is deprecated. In a future version, it will default to False. Select only valid columns or specify the value of numeric_onl
y to silence this warning.
  mask=np.triu(np.ones_like(df2.corr(),dtype=bool))
C:\Users\oscah\AppData\Local\Temp\ipykernel_8532\3122278506.py:3: FutureWarning: The default value of numeric_only in DataFrame.
corr is deprecated. In a future version, it will default to False. Select only valid columns or specify the value of numeric_onl
y to silence this warning.
  heatmap=sns.heatmap(df2.corr(),mask=mask, vmin=-1,annot=True,cmap='BrBG')
```

```
Out[ ]: Text(0.5, 1.0, 'Mapa de Calor de Triangulo de Correlacion')
```

Mapa de Calor de Triangulo de Correlacion



age								
housing	0.00029							
loan	-0.0064	0.045						
duration	0.0024	-0.0091	0.00028					
campaign	0.0055	-0.011	0.0039	-0.071				
pdays	-0.038	-0.0094	0.0019	-0.044	0.052			
previous	0.028	0.021	-0.0033	0.016	-0.078	-0.58		
cons.price.idx	-0.0012	-0.081	-0.0031	0.0075	0.13	0.081	-0.21	
cons.conf.idx	0.13	-0.034	-0.013	-0.0087	-0.011	-0.091	-0.057	0.071



In [ ]:

```
# Ya no tengo la multicolineraidad entre las variables independientes.
# El dataframe final es df2
```

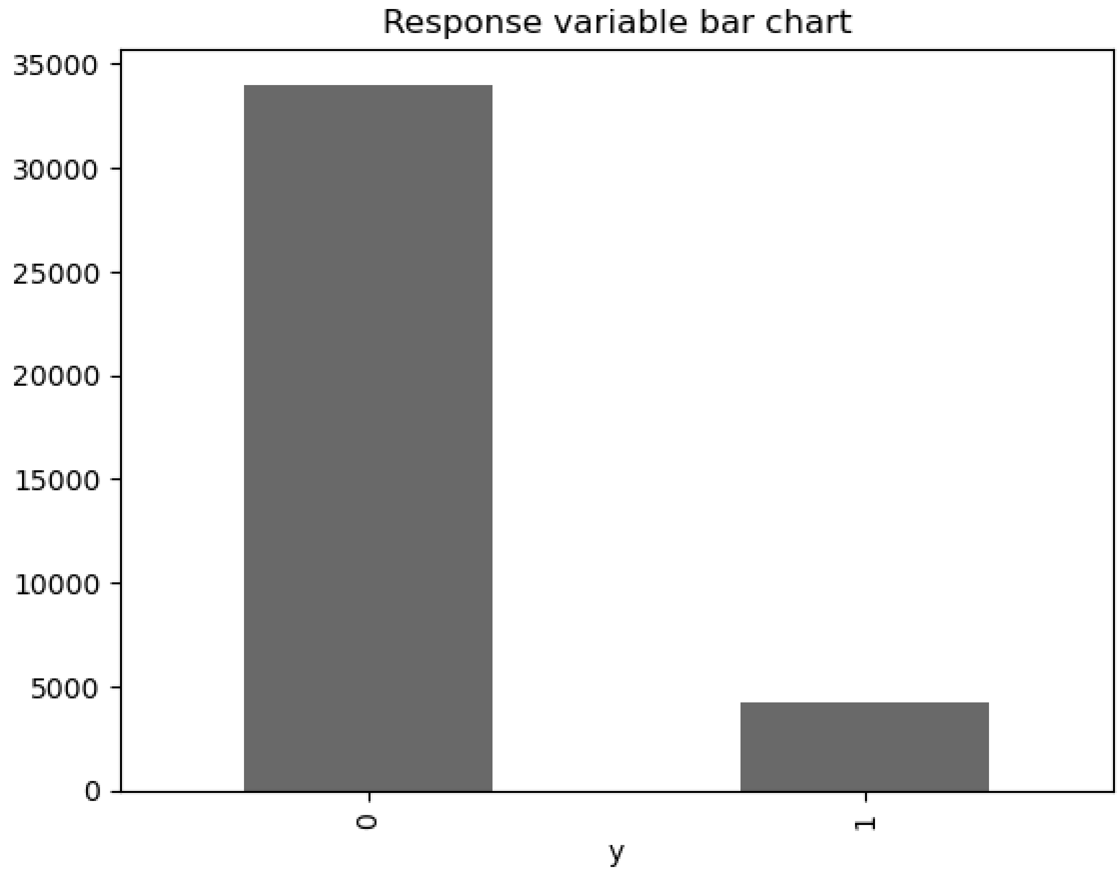
Analisis univariado y bivariado basado en la predicción (y/n)

In [ ]:

```
df2.groupby('y')['y'].count().plot.bar(color='dimgrey',title='Response variable bar chart')
```

Out[ ]:

```
<AxesSubplot: title={'center': 'Response variable bar chart'}, xlabel='y'>
```



In [ ]:

```
neg_answer=sum(df2.y == 0)
pos_answer=sum(df2.y == 1)
total_answer= neg_answer + pos_answer
print(f'El porcentaje de personas que aceptaron la campana es de {(pos_answer/total_answer)*100:.2f}%')
```

```
El porcentaje de personas que aceptaron la campana es de 11.13%
```

In [ ]:

```
df2.groupby(['y']).median().T
```

```
C:\Users\oscah\AppData\Local\Temp\ipykernel_8532\1785912231.py:1: FutureWarning: The default value of numeric_only in DataFrameG
roupBy.median is deprecated. In a future version, numeric_only will default to False. Either specify numeric_only or select only
columns which should be valid for the function.
  df2.groupby(['y']).median().T
```

Out[ ]:

y	0	1
age	38.00	37.00
housing	1.00	1.00
loan	0.00	0.00
duration	164.00	453.50
campaign	2.00	2.00
pdays	999.00	999.00
previous	0.00	0.00
cons.price.idx	93.92	93.20
cons.conf.idx	-41.80	-40.80
nr.employed	5195.80	5099.10

In [ ]:

```
# No se persive una gran diferencia entre las dos columnas de variables de respuesta
```

In [ ]:

```
# Antes de hacer la separacion del Dataframe se elimina la columna duration
# ya que era aconsejado por el propiertario del dataset (para usos de prediccion):
```

*11 - duration: last contact duration, in seconds (numeric). Important note: this attribute highly affects the output target (e.g., if duration=0 then y="no"). Yet, the duration is not known before a call is performed. Also, after the end of the call y is obviously known. Thus, this input should only be included for benchmark purposes and should be discarded if the intention is to have a realistic predictive model.

In [ ]:

```
df2.drop(['duration'],axis=1,inplace=True)
# Final dataframe
df2.sample(5)
```

Out[ ]:

	age	job	marital	education	default	housing	loan	contact	month	day_of_week	campaign	pdays	previous	poutcome	cons.price.id
16352	27	blue-collar	single	basic.9y	unknown	0	0	cellular	jul	wed	8	999	0	nonexistent	93.9
23800	50	blue-collar	married	basic.4y	unknown	1	0	cellular	aug	fri	1	999	0	nonexistent	93.4
17285	52	blue-collar	married	basic.9y	unknown	0	1	cellular	jul	fri	3	999	0	nonexistent	93.9
33135	28	services	single	high.school	no	1	1	cellular	may	tue	5	999	0	nonexistent	92.8
15910	31	blue-collar	married	basic.9y	no	1	1	cellular	jul	mon	3	999	0	nonexistent	93.9

Dividir dataset entre training y test (70:30)

In [ ]:

```
# Libreria de Split
from sklearn.model_selection import train_test_split

x = df2.drop('y',axis=1)
y = df2['y']
#Se divide a X y Y en un ratio 70:30

x_train, x_test, y_train, y_test = train_test_split(x,y,test_size=0.3,random_state=1)
```

In [ ]:

```
x.sample(5)
```

Out[ ]:

	age	job	marital	education	default	housing	loan	contact	month	day_of_week	campaign	pdays	previous	poutcome	cor
40500	32	admin.	married	university.degree	no	0	0	telephone	aug	fri	1	999	0	nonexistent	
18646	33	admin.	single	professional.course	no	1	0	cellular	jul	thu	2	999	0	nonexistent	
22653	35	technician	single	professional.course	no	0	1	cellular	aug	fri	4	999	0	nonexistent	
26460	53	technician	married	professional.course	no	0	0	cellular	nov	thu	2	999	1	failure	
25492	38	admin.	married	high.school	no	1	0	telephone	nov	wed	1	999	0	nonexistent	

In [ ]:

```
y.sample(5)
```

Out[ ]:

```
26784    0
29640    0
21237    0
3685     1
29677    0
Name: y, dtype: int64
```

In [ ]:

```
x_train.sample(3)
```

Out[ ]:

	age	job	marital	education	default	housing	loan	contact	month	day_of_week	campaign	pdays	previous	poutcome
7478	50	technician	married	professional.course	no	1	0	telephone	may	fri	2	999	0	nonexistent
7047	33	blue-collar	married	basic.9y	no	0	0	telephone	may	thu	1	999	0	nonexistent
24476	44	management	married	university.degree	no	1	0	cellular	nov	mon	1	999	0	nonexistent

In [ ]:

```
print('{0:0.2f}% data is in training set'.format((len(x_train)/len(df2.index))*100))
print('{0:0.2f}% data is in test set'.format((len(x_test)/len(df2.index))*100))
```

```
70.00% data is in training set
30.00% data is in test set
```

In [ ]:

```
# Validacion de la estructura de los datasets
# En este caso la variable "Response" tiene 15/85 en cuanto a 1/0 y deberia perdurar en el Original, training y testing
# Esa es justamente la idea de hacer el split
print('Original campaign True Values : {0} ({1:0.2f}%)'.format(len(df2.loc[df2['y']==1]),(len(df2.loc[df2['y']==1])/len(df2.inde
print('Original campaign False Values : {0} ({1:0.2f}%)'.format(len(df2.loc[df2['y']==0]),(len(df2.loc[df2['y']==0])/len(df2.ind
print('')
print('Original campaign True Values : {0} ({1:0.2f}%)'.format(len(y_train[y_train[:]==1]),(len(y_train[y_train[:]==1])/len(y_tra
print('Original campaign False Values : {0} ({1:0.2f}%)'.format(len(y_train[y_train[:]==0]),(len(y_train[y_train[:]==0])/len(y_tr
print('')
print('Original campaign True Values : {0} ({1:0.2f}%)'.format(len(y_test[y_test[:]==1]),(len(y_test[y_test[:]==1])/len(y_test.in
print('Original campaign False Values : {0} ({1:0.2f}%)'.format(len(y_test[y_test[:]==0]),(len(y_test[y_test[:]==0])/len(y_test.
```

```
Original campaign True Values : 4258 (11.13%)
Original campaign False Values : 33987 (88.87%)

Original campaign True Values : 2982 (11.14%)
Original campaign False Values : 23789 (88.86%)

Original campaign True Values : 1276 (11.12%)
Original campaign False Values : 10198 (88.88%)
```