bank2

April 20, 2024

[1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
```

[2]:
```
df = pd.read_csv('C:\\Users\\EL HASSANI␣
↪SAFAA\\Desktop\\Task3_dataset\\bank-additional\\bank-additional.
↪csv',delimiter=';')
df.head()
```

[2]:

	age	job	marital	education	default	housing	loan	\
0	30	blue-collar	married	basic.9y	no	yes	no	
1	39	services	single	high.school	no	no	no	
2	25	services	married	high.school	no	yes	no	
3	38	services	married	basic.9y	no	unknown	unknown	
4	47	admin.	married	university.degree	no	yes	no	

	contact	month	day_of_week	…	campaign	pdays	previous	poutcome	\
0	cellular	may	fri	…	2	999	0	nonexistent	
1	telephone	may	fri	…	4	999	0	nonexistent	
2	telephone	jun	wed	…	1	999	0	nonexistent	
3	telephone	jun	fri	…	3	999	0	nonexistent	
4	cellular	nov	mon	…	1	999	0	nonexistent	

	emp.var.rate	cons.price.idx	cons.conf.idx	euribor3m	nr.employed	y
0	-1.8	92.893	-46.2	1.313	5099.1	no
1	1.1	93.994	-36.4	4.855	5191.0	no
2	1.4	94.465	-41.8	4.962	5228.1	no
3	1.4	94.465	-41.8	4.959	5228.1	no
4	-0.1	93.200	-42.0	4.191	5195.8	no

[5 rows x 21 columns]

[3]:
```
df.tail()
```

[3]:

	age	job	marital	education	default	housing	loan	contact	\
4114	30	admin.	married	basic.6y	no	yes	yes	cellular	

```
4115   39      admin.  married  high.school      no     yes   no  telephone
4116   27    student   single  high.school      no      no   no   cellular
4117   58      admin.  married  high.school      no      no   no   cellular
4118   34  management   single  high.school      no     yes   no   cellular

     month day_of_week  …  campaign  pdays  previous     poutcome  \
4114   jul         thu  …         1    999         0  nonexistent
4115   jul         fri  …         1    999         0  nonexistent
4116   may         mon  …         2    999         1      failure
4117   aug         fri  …         1    999         0  nonexistent
4118   nov         wed  …         1    999         0  nonexistent

     emp.var.rate  cons.price.idx  cons.conf.idx  euribor3m  nr.employed   y
4114          1.4          93.918          -42.7      4.958       5228.1  no
4115          1.4          93.918          -42.7      4.959       5228.1  no
4116         -1.8          92.893          -46.2      1.354       5099.1  no
4117          1.4          93.444          -36.1      4.966       5228.1  no
4118         -0.1          93.200          -42.0      4.120       5195.8  no

[5 rows x 21 columns]
```

[4]:
```
df.shape
```

[4]:
```
(4119, 21)
```

[5]:
```
df.columns
```

[5]:
```
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')
```

[6]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 4119 entries, 0 to 4118
Data columns (total 21 columns):
 #   Column          Non-Null Count  Dtype
---  ------          --------------  -----
 0   age             4119 non-null   int64
 1   job             4119 non-null   object
 2   marital         4119 non-null   object
 3   education       4119 non-null   object
 4   default         4119 non-null   object
 5   housing         4119 non-null   object
 6   loan            4119 non-null   object
```

```
 7   contact         4119 non-null   object
 8   month           4119 non-null   object
 9   day_of_week     4119 non-null   object
 10  duration        4119 non-null   int64
 11  campaign        4119 non-null   int64
 12  pdays           4119 non-null   int64
 13  previous        4119 non-null   int64
 14  poutcome        4119 non-null   object
 15  emp.var.rate    4119 non-null   float64
 16  cons.price.idx  4119 non-null   float64
 17  cons.conf.idx   4119 non-null   float64
 18  euribor3m       4119 non-null   float64
 19  nr.employed     4119 non-null   float64
 20  y               4119 non-null   object
dtypes: float64(5), int64(5), object(11)
memory usage: 675.9+ KB
```

[7]:
```
df.describe()
```

[7]:

	age	duration	campaign	pdays	previous
count	4119.000000	4119.000000	4119.000000	4119.000000	4119.000000
mean	40.113620	256.788055	2.537266	960.422190	0.190337
std	10.313362	254.703736	2.568159	191.922786	0.541788
min	18.000000	0.000000	1.000000	0.000000	0.000000
25%	32.000000	103.000000	1.000000	999.000000	0.000000
50%	38.000000	181.000000	2.000000	999.000000	0.000000
75%	47.000000	317.000000	3.000000	999.000000	0.000000
max	88.000000	3643.000000	35.000000	999.000000	6.000000

	emp.var.rate	cons.price.idx	cons.conf.idx	euribor3m	nr.employed
count	4119.000000	4119.000000	4119.000000	4119.000000	4119.000000
mean	0.084972	93.579704	-40.499102	3.621356	5166.481695
std	1.563114	0.579349	4.594578	1.733591	73.667904
min	-3.400000	92.201000	-50.800000	0.635000	4963.600000
25%	-1.800000	93.075000	-42.700000	1.334000	5099.100000
50%	1.100000	93.749000	-41.800000	4.857000	5191.000000
75%	1.400000	93.994000	-36.400000	4.961000	5228.100000
max	1.400000	94.767000	-26.900000	5.045000	5228.100000

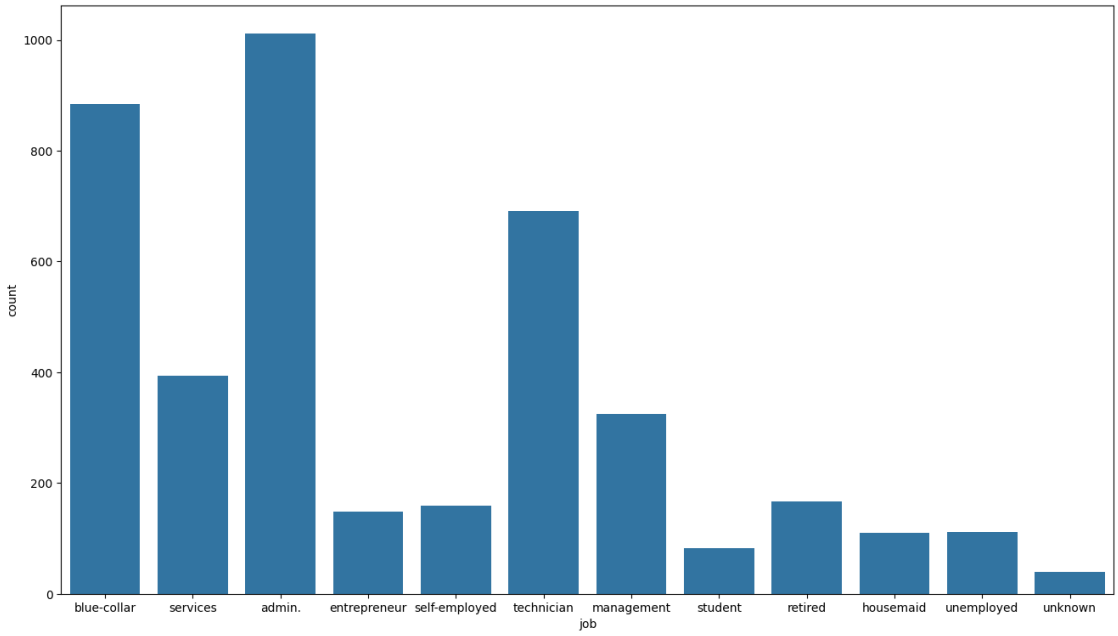
[8]:
```
df.isnull().sum()
```

[8]:
```
age             0
job             0
marital         0
education       0
default         0
housing         0
```

```
loan              0
contact           0
month             0
day_of_week       0
duration          0
campaign          0
pdays             0
previous          0
poutcome          0
emp.var.rate      0
cons.price.idx    0
cons.conf.idx     0
euribor3m         0
nr.employed       0
y                 0
dtype: int64
```

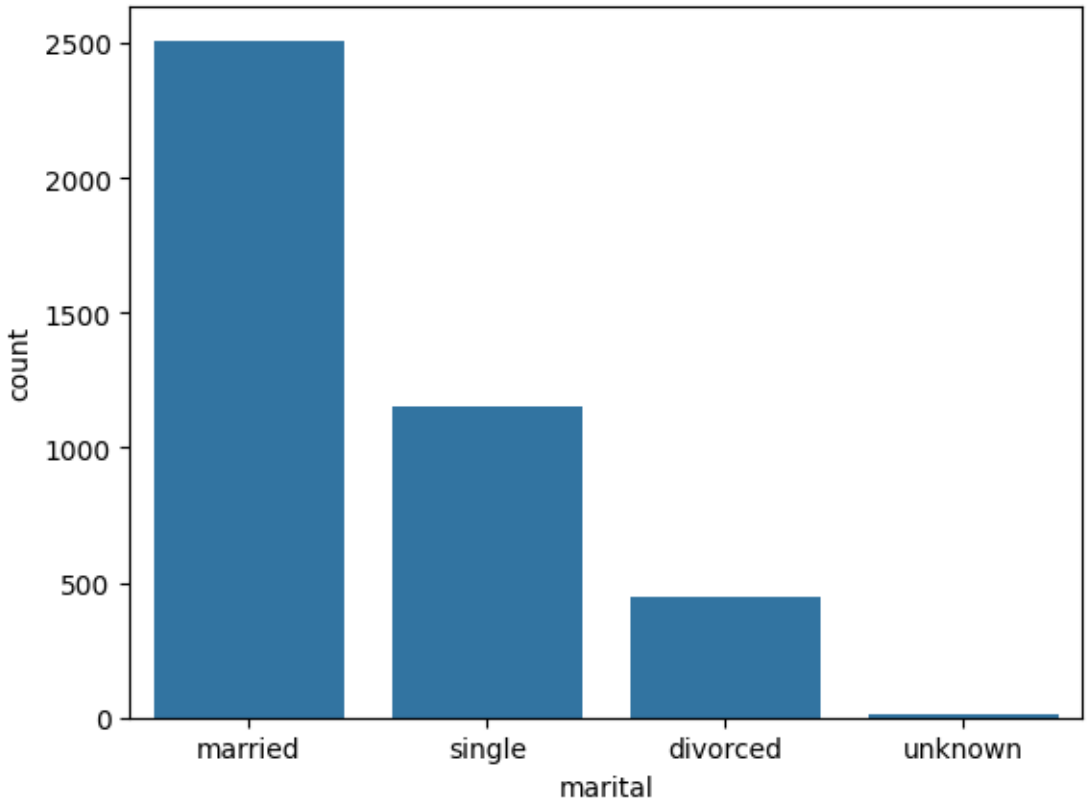
[9]:
```
plt.figure(figsize = (16,9))
sns.countplot(x = "job",data = df)
```

[9]:
```
<Axes: xlabel='job', ylabel='count'>
```



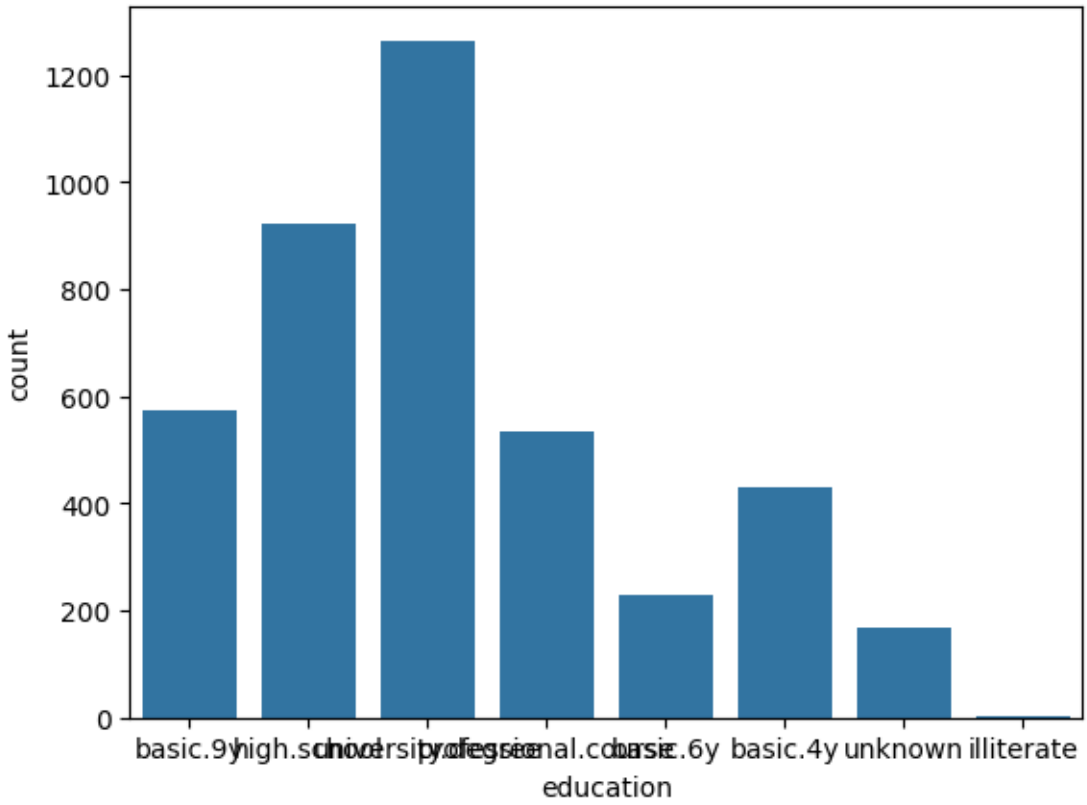
[10]:
```
sns.countplot(x = "marital",data = df)
```

[10]:
```
<Axes: xlabel='marital', ylabel='count'>
```



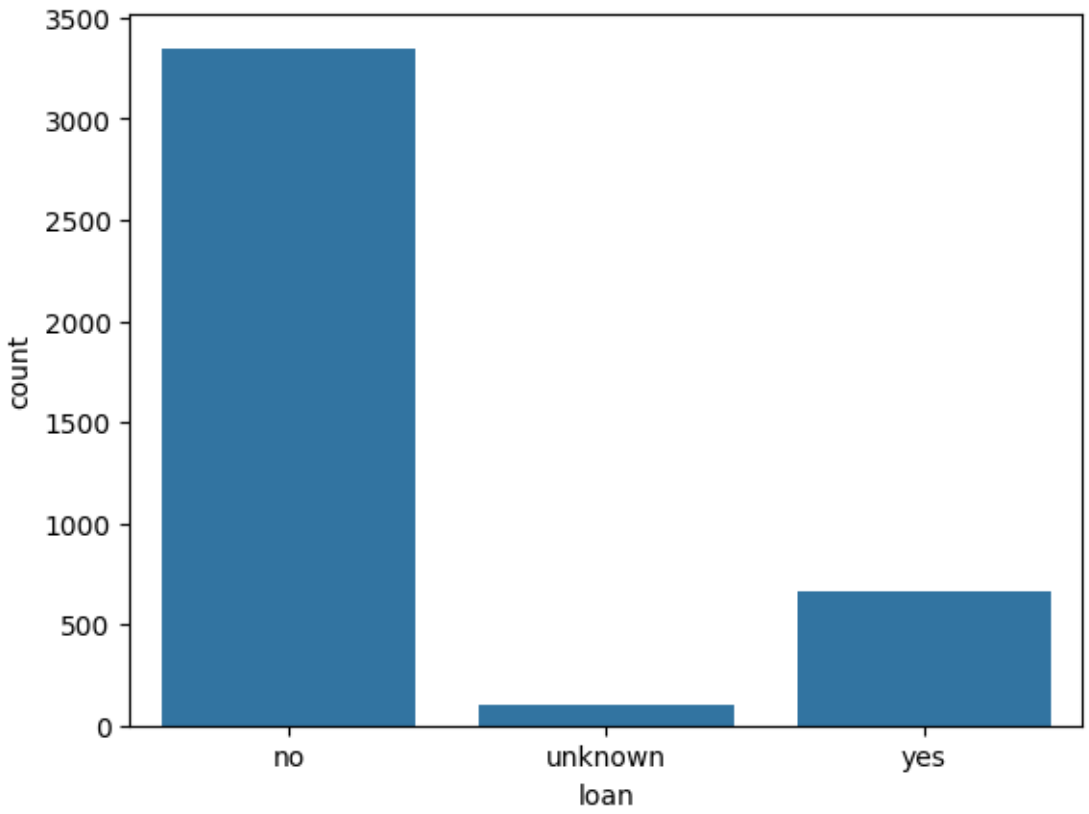
[11]:
```
sns.countplot(x = "education",data = df)
```

[11]: <Axes: xlabel='education', ylabel='count'>



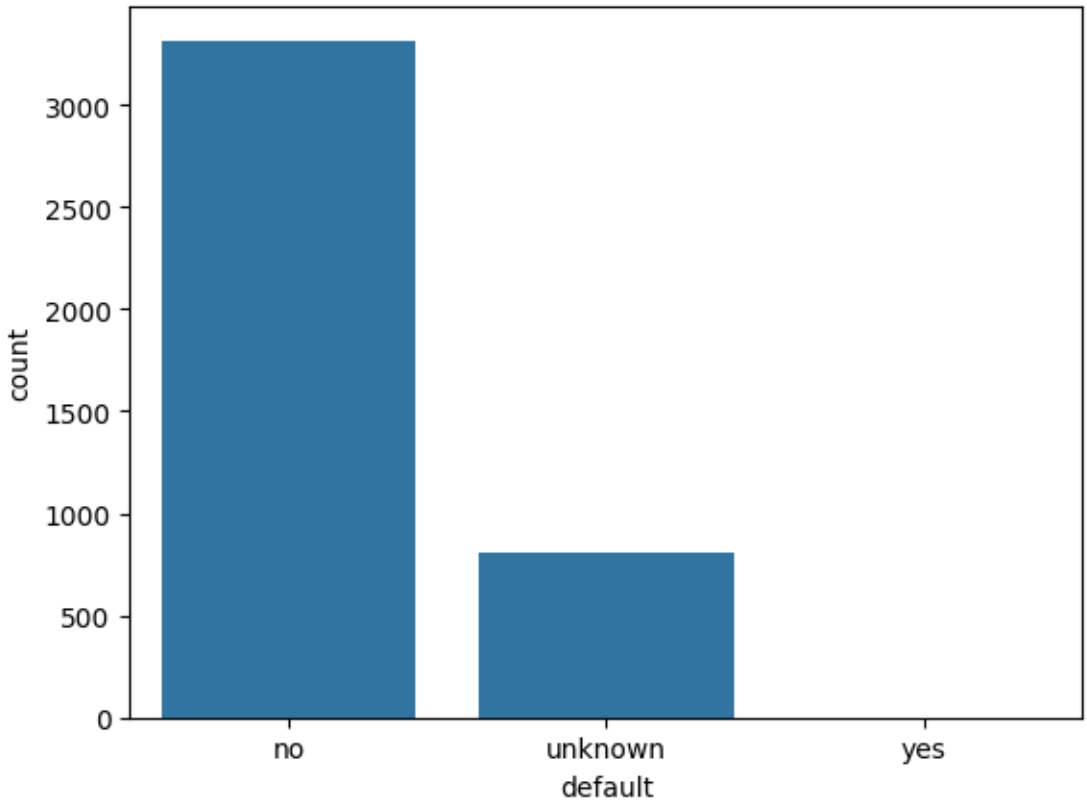
[12]:
```
sns.countplot(x = "loan",data = df)
```

[12]: <Axes: xlabel='loan', ylabel='count'>



[13]:
```
sns.countplot(x = "default",data = df)
```

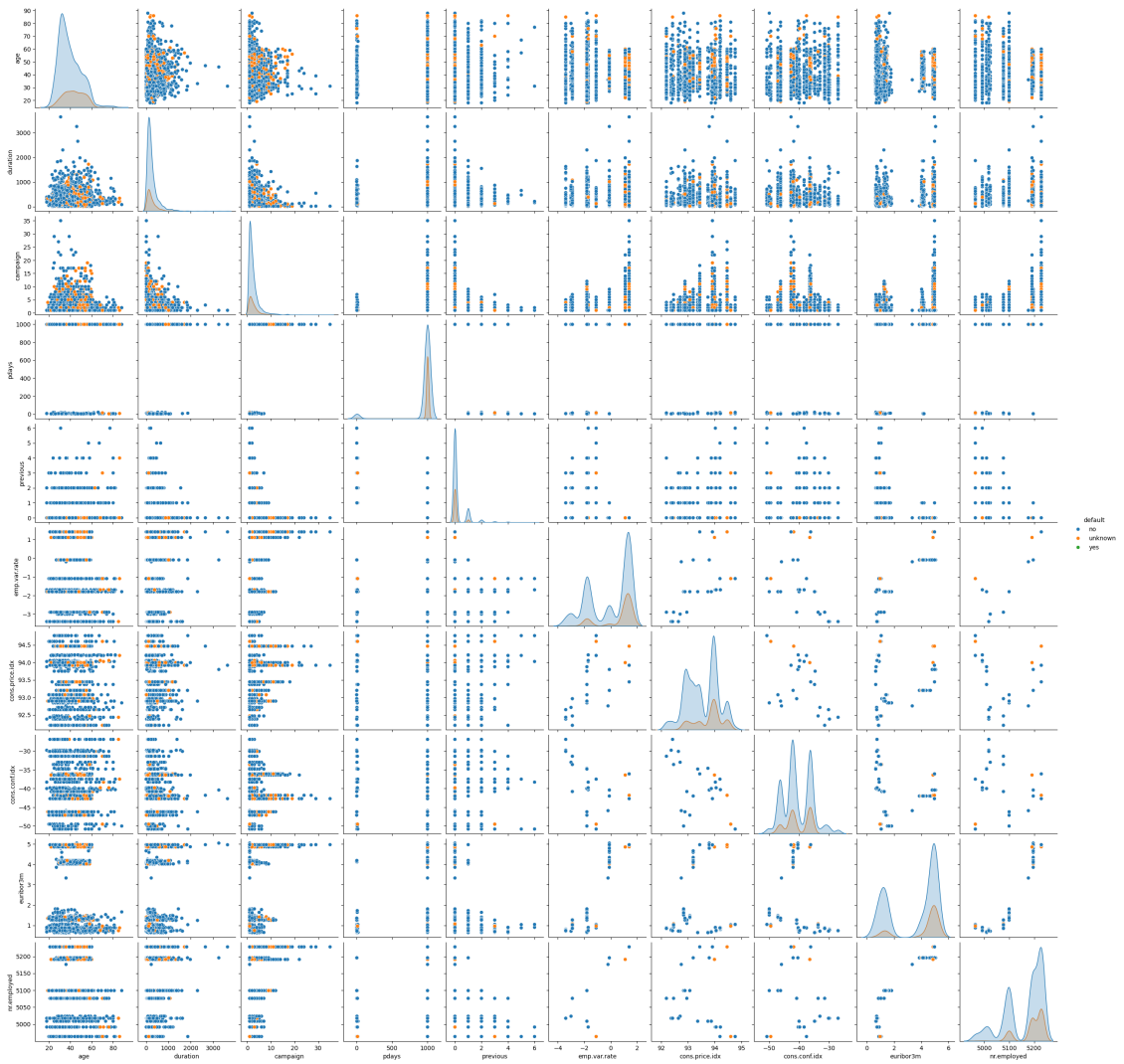
[13]: <Axes: xlabel='default', ylabel='count'>



[14]:
```
plt.figure(figsize = (16,9))
sns.pairplot(data = df,hue = "default")
```

[14]:
```
<seaborn.axisgrid.PairGrid at 0x14f61f650d0>

<Figure size 1600x900 with 0 Axes>
```



[16]:
```
my_df=df.select_dtypes(exclude=[object])
my_df.corr()
```

[16]:

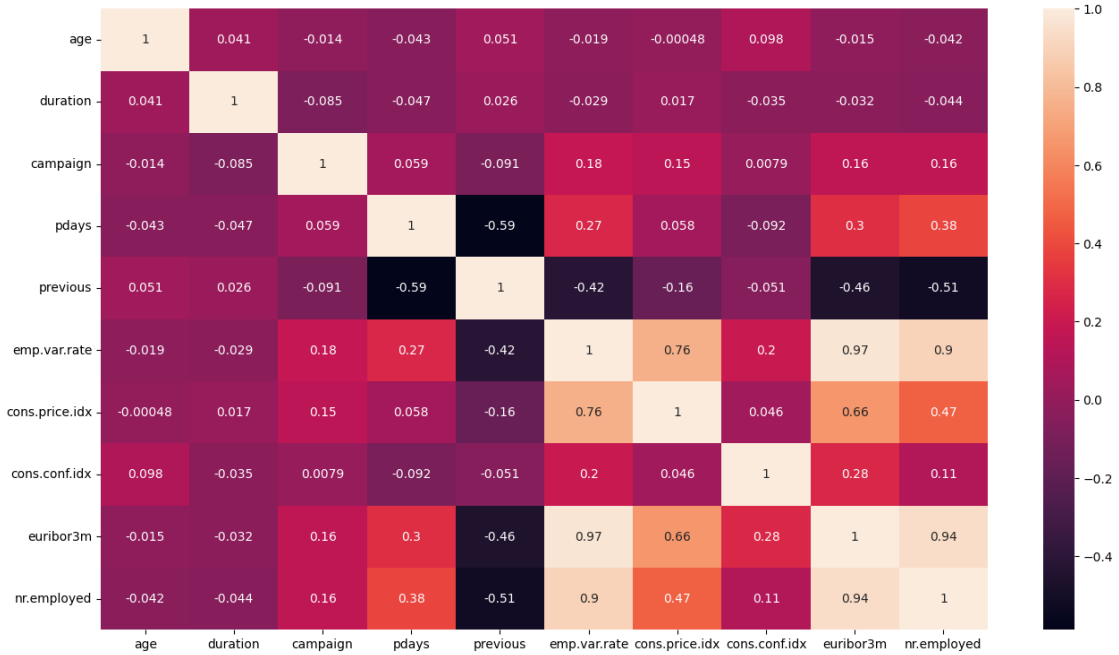
	age	duration	campaign	pdays	previous	\
age	1.000000	0.041299	-0.014169	-0.043425	0.050931	
duration	0.041299	1.000000	-0.085348	-0.046998	0.025724	
campaign	-0.014169	-0.085348	1.000000	0.058742	-0.091490	
pdays	-0.043425	-0.046998	0.058742	1.000000	-0.587941	
previous	0.050931	0.025724	-0.091490	-0.587941	1.000000	
emp.var.rate	-0.019192	-0.028848	0.176079	0.270684	-0.415238	
cons.price.idx	-0.000482	0.016672	0.145021	0.058472	-0.164922	
cons.conf.idx	0.098135	-0.034745	0.007882	-0.092090	-0.051420	
euribor3m	-0.015033	-0.032329	0.159435	0.301478	-0.458851	
nr.employed	-0.041936	-0.044218	0.161037	0.381983	-0.514853	

```
                emp.var.rate  cons.price.idx  cons.conf.idx  euribor3m  \
age                -0.019192       -0.000482       0.098135  -0.015033
duration           -0.028848        0.016672      -0.034745  -0.032329
campaign            0.176079        0.145021       0.007882   0.159435
pdays               0.270684        0.058472      -0.092090   0.301478
previous           -0.415238       -0.164922      -0.051420  -0.458851
emp.var.rate        1.000000        0.755155       0.195022   0.970308
cons.price.idx      0.755155        1.000000       0.045835   0.657159
cons.conf.idx       0.195022        0.045835       1.000000   0.276595
euribor3m           0.970308        0.657159       0.276595   1.000000
nr.employed         0.897173        0.472560       0.107054   0.942589

                nr.employed
age               -0.041936
duration          -0.044218
campaign           0.161037
pdays              0.381983
previous          -0.514853
emp.var.rate       0.897173
cons.price.idx     0.472560
cons.conf.idx      0.107054
euribor3m          0.942589
nr.employed        1.000000
```

[17]:
```
plt.figure(figsize = (16,9))
sns.heatmap(my_df.corr(),annot = True)
```

[17]:
```
<Axes: >
```



[18]:
```
from sklearn.preprocessing import LabelEncoder
le = LabelEncoder()
```

[19]:
```
df["job"] = le.fit_transform(df["job"])
df["marital"] = le.fit_transform(df["marital"])
df["education"] = le.fit_transform(df["education"])
df["default"] = le.fit_transform(df["default"])
df["loan"] = le.fit_transform(df["loan"])
df["contact"] = le.fit_transform(df["contact"])
df["poutcome"] = le.fit_transform(df["poutcome"])
df["housing"] = le.fit_transform(df["housing"])
df["month"] = le.fit_transform(df["month"])
```

[20]:
```
df.head()
```

[20]:

	age	job	marital	education	default	housing	loan	contact	month	\
0	30	1	1	2	0	2	0	0	6	
1	39	7	2	3	0	0	0	1	6	
2	25	7	1	3	0	2	0	1	4	
3	38	7	1	2	0	1	1	1	4	
4	47	0	1	6	0	2	0	0	7	

	day_of_week	…	campaign	pdays	previous	poutcome	emp.var.rate	\
0	fri	…	2	999	0	1	-1.8	
1	fri	…	4	999	0	1	1.1	
2	wed	…	1	999	0	1	1.4	

```
3         fri  …         3    999         0         1          1.4
4         mon  …         1    999         0         1         -0.1

   cons.price.idx  cons.conf.idx  euribor3m  nr.employed   y
0          92.893          -46.2      1.313       5099.1  no
1          93.994          -36.4      4.855       5191.0  no
2          94.465          -41.8      4.962       5228.1  no
3          94.465          -41.8      4.959       5228.1  no
4          93.200          -42.0      4.191       5195.8  no

[5 rows x 21 columns]
```

[21]:
```
df.drop(["pdays","previous","poutcome"],axis = 1)
df.head()
```

[21]:
```
   age  job  marital  education  default  housing  loan  contact  month  \
0   30    1        1          2        0        2     0        0      6
1   39    7        2          3        0        0     0        1      6
2   25    7        1          3        0        2     0        1      4
3   38    7        1          2        0        1     1        1      4
4   47    0        1          6        0        2     0        0      7

  day_of_week  …  campaign  pdays  previous  poutcome  emp.var.rate  \
0         fri  …         2    999         0         1          -1.8
1         fri  …         4    999         0         1           1.1
2         wed  …         1    999         0         1           1.4
3         fri  …         3    999         0         1           1.4
4         mon  …         1    999         0         1          -0.1

   cons.price.idx  cons.conf.idx  euribor3m  nr.employed   y
0          92.893          -46.2      1.313       5099.1  no
1          93.994          -36.4      4.855       5191.0  no
2          94.465          -41.8      4.962       5228.1  no
3          94.465          -41.8      4.959       5228.1  no
4          93.200          -42.0      4.191       5195.8  no

[5 rows x 21 columns]
```

[ ]: