EDA 06 - Data Wrangling (Normalization , Discretization and Feature Encoding)

1. Necessary Imports

In [64]:
```
import pandas as pd
import numpy as np
import seaborn as sns
```

2. Loading Dataset

In [5]:
```
data = pd.read_csv("D:/FTI/Cohort 2 EDA/e-cohort2/Lecture 6 Data Wrangling/Finance.csv")
```

In [6]:
```
data.head()
```

Out[6]:

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

In [7]:
```
data.shape
```

Out[7]:
```
(45211, 17)
```

In [8]:
```
data.dtypes
```

Out[8]:
```
age            int64
job           object
marital       object
education     object
default       object
balance        int64
housing       object
loan          object
contact       object
day            int64
month         object
duration       int64
campaign       int64
pdays          int64
previous       int64
poutcome      object
y             object
dtype: object
```

3. Discretization

a) Discretization of Age

In [9]:
```
data['age']  = np.where((data['age'] <20) ,'Teenager',
                                 np.where((data['age'] >=20) & (data
['age'] <=30),'Adult',
                                np.where((data['age']>30) & (data['ag
e'] <=50),'Middle Aged',
                                         'old')))
```

In [10]:
```
data.head()
```

Out[10]:

	age	job	marital	education	default	balance	housing	loan	contact	day
0	old	management	married	tertiary	no	2143	yes	no	unknown	5
1	Middle Aged	technician	single	secondary	no	29	yes	no	unknown	5
2	Middle Aged	entrepreneur	married	secondary	no	2	yes	yes	unknown	5
3	Middle Aged	blue-collar	married	unknown	no	1506	yes	no	unknown	5
4	Middle Aged	unknown	single	unknown	no	1	no	no	unknown	5

b) Discretization of balance

In [24]:
```
data['balance'].value_counts()
```

Out[24]:
```
0         3514
1          195
2          156
4          139
3          134
          ...
4305         1
6352         1
18881        1
14889        1
7218         1
Name: balance, Length: 7168, dtype: int64
```

In [25]:
```
data['balance'].mean()
```

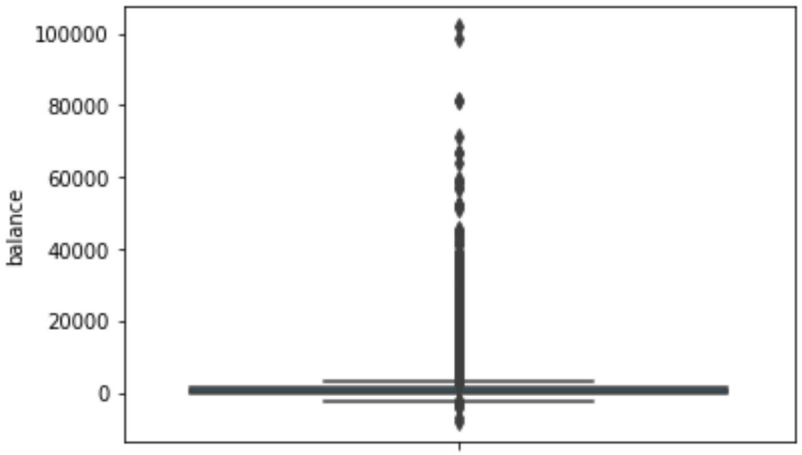
Out[25]:
```
1362.2720576850766
```

In [26]:
```
data['balance'].max()
```

Out[26]:
```
102127
```

In [27]:
```
sns.boxplot( y = 'balance', data = data)
```

Out[27]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x25707da7940>
```



In [28]:
```
(data['balance']<0).sum()
```

Out[28]:
```
3766
```

In [29]:
```
((data['balance']>0) & (data['balance']<1200)).sum()
```

Out[29]:
```
24968
```

In [30]:
```
((data['balance']>1200) & (data['balance']<1500)).sum()
```

Out[30]:
```
2057
```

In [31]:
```
((data['balance']>1500) & (data['balance']<30000)).sum()
```

Out[31]:
```
10843
```

In [32]:
```
((data['balance']>30000).sum())
```

Out[32]: 52

In [33]:
```
data['balance']  = np.where((data['balance'] <0) ,'Negative',
                             np.where((data['balance'] >=0) & (dat
a['balance'] <=1200),'Low',
                             np.where((data['balance']>1200) & (da
ta['balance'] <=1500),'Average',
                             np.where((data['balance']>1500) & (da
ta['balance'] <=30000),'High',
                                      'very high'))))
```

In [34]:
```
data.head()
```

Out[34]:

	age	job	marital	education	default	balance	housing	loan	contact	day
0	old	management	married	tertiary	no	High	yes	no	unknown	5
1	Middle Aged	technician	single	secondary	no	Low	yes	no	unknown	5
2	Middle Aged	entrepreneur	married	secondary	no	Low	yes	yes	unknown	5
3	Middle Aged	blue-collar	married	unknown	no	High	yes	no	unknown	5
4	Middle Aged	unknown	single	unknown	no	Low	no	no	unknown	5

In [35]:
```
data['day'].value_counts()
```

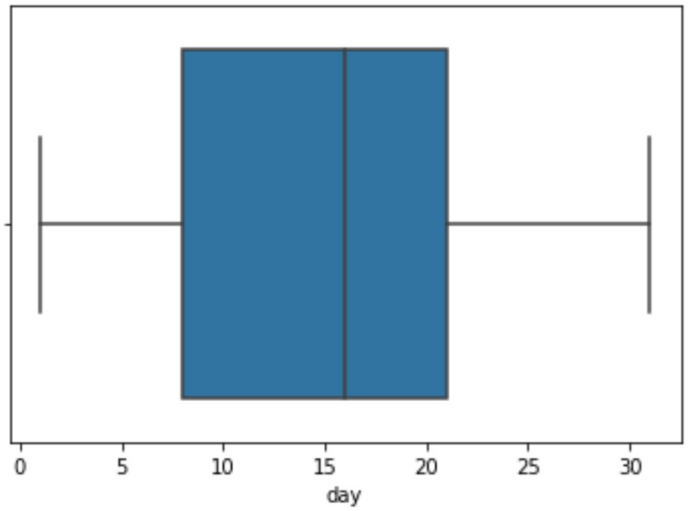
Out[35]:
```
20    2752
18    2308
21    2026
17    1939
6     1932
5     1910
14    1848
8     1842
28    1830
7     1817
19    1757
29    1745
15    1703
12    1603
13    1585
30    1566
9     1561
11    1479
4     1445
16    1415
2     1293
27    1121
3     1079
26    1035
23     939
22     905
25     840
31     643
10     524
24     447
1      322
Name: day, dtype: int64
```

In [36]:
```
data['day'].mean()
```

Out[36]:
```
15.80641879188693
```

In [37]:
```
sns.boxplot(x='day',data=data)
```

Out[37]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x25707e35160>
```



In [38]:
```
data['day'].max()
```

Out[38]:
```
31
```

In [39]:
```
data.dtypes
```

Out[39]:
```
age          object
job          object
marital      object
education    object
default      object
balance      object
housing      object
loan         object
contact      object
day           int64
month        object
duration      int64
campaign      int64
pdays         int64
previous      int64
poutcome     object
y            object
dtype: object
```

In [40]:
```
data['day']  = np.where((data['day'] <5) ,'Below5',
                                np.where((data['day'] >=5) & (data['day'] <=10),'Between5-10',
                                np.where((data['day']>10) & (data['day'] <=20),'Between 10&20',
                                'Above 20')))
```

In [41]:
```
data.head()
```

Out[41]:

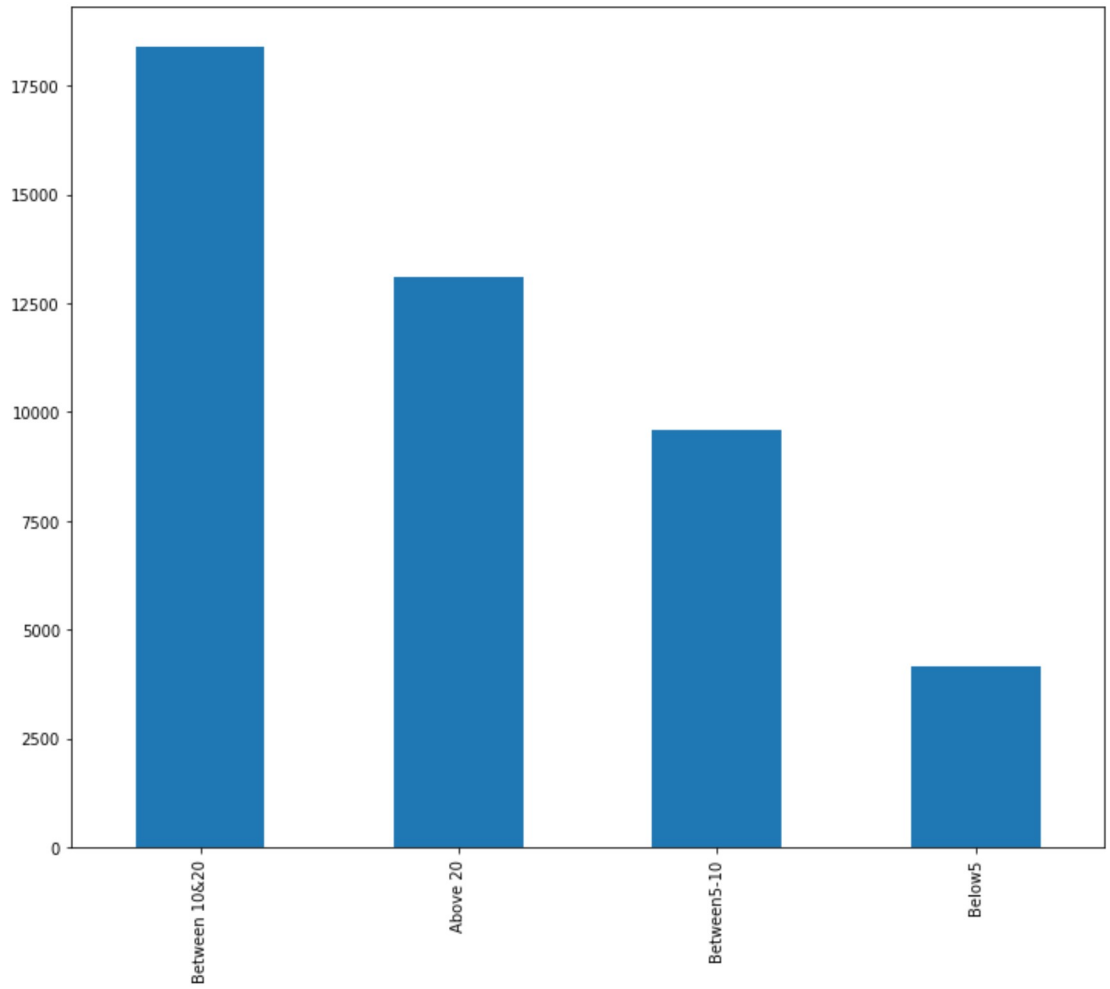
	age	job	marital	education	default	balance	housing	loan	contact	
0	old	management	married	tertiary	no	High	yes	no	unknown	Betw
1	Middle Aged	technician	single	secondary	no	Low	yes	no	unknown	Betw
2	Middle Aged	entrepreneur	married	secondary	no	Low	yes	yes	unknown	Betw
3	Middle Aged	blue-collar	married	unknown	no	High	yes	no	unknown	Betw
4	Middle Aged	unknown	single	unknown	no	Low	no	no	unknown	Betw

In [42]:
```
data['day'].value_counts()
```

Out[42]:
```
Between 10&20    18389
Above 20         13097
Between5-10       9586
Below5            4139
Name: day, dtype: int64
```

In [43]:
```
data['day'].value_counts().plot(kind='bar', figsize=(12,10))
```

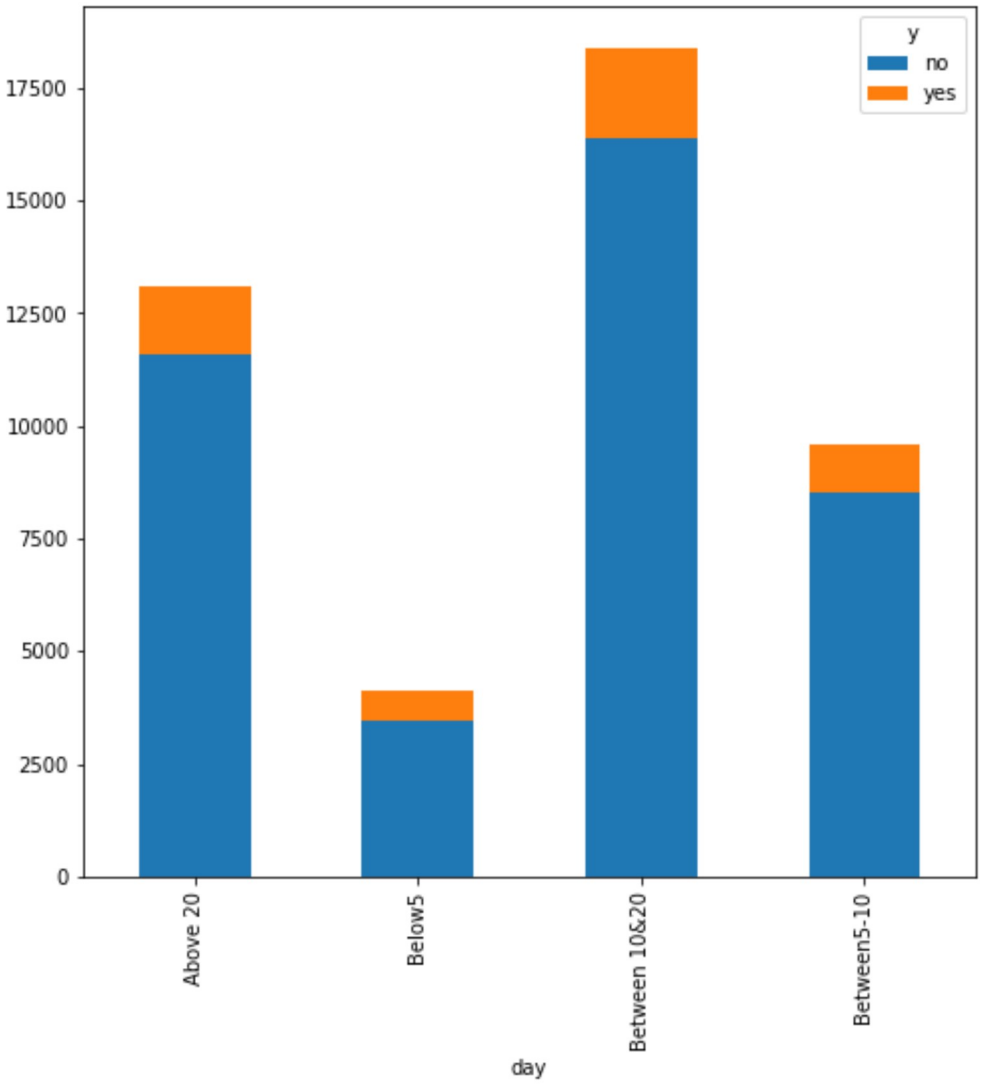
Out[43]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x25708be4d30>
```



In [44]:
```
tab=pd.crosstab(data['day'],data['y'])
```

In [45]:
```
tab.plot(kind="bar",
                  figsize=(8,8),
                  stacked=True)
```

Out[45]: <matplotlib.axes._subplots.AxesSubplot at 0x25708093668>



4.) Normalization

a) Normalization : Duration Column

In [218]:
```
data['duration'].value_counts().unique()
```

Out[218]:
```
array([188, 184, 177, 175, 174, 173, 170, 169, 168, 166, 165, 164,
163,
       162, 161, 160, 159, 157, 156, 155, 154, 153, 152, 151, 150,
149,
       148, 147, 146, 145, 144, 142, 141, 140, 139, 138, 137, 136,
135,
       134, 133, 132, 131, 130, 129, 128, 127, 126, 125, 124, 123,
122,
       121, 120, 119, 118, 117, 116, 115, 113, 112, 111, 110, 108,
107,
       106, 105, 104, 103, 101, 100,  99,  97,  96,  95,  94,  93,
92,
        91,  90,  89,  88,  87,  86,  85,  84,  83,  82,  81,  80,
79,
        78,  77,  76,  75,  73,  72,  71,  70,  68,  67,  66,  65,
64,
        63,  62,  61,  60,  58,  57,  56,  55,  54,  53,  52,  50,
49,
        48,  47,  45,  44,  43,  42,  41,  40,  39,  38,  37,  36,
35,
        34,  33,  32,  31,  30,  29,  28,  27,  26,  25,  24,  23,
22,
        21,  20,  19,  18,  17,  16,  15,  14,  13,  12,  11,  10,
9,
         8,   7,   6,   5,   4,   3,   2,   1], dtype=int64)
```

In [220]:
```
data
```

Out[220]:

	age	job	marital	education	default	balance	housing	loan	contact
0	old	management	married	tertiary	no	High	yes	no	unknowr
1	Middle Aged	technician	single	secondary	no	Low	yes	no	unknowr
2	Middle Aged	entrepreneur	married	secondary	no	Low	yes	yes	unknowr
3	Middle Aged	blue-collar	married	unknown	no	High	yes	no	unknowr
4	Middle Aged	unknown	single	unknown	no	Low	no	no	unknowr
5	Middle Aged	management	married	tertiary	no	Low	yes	no	unknowr
6	Adult	management	single	tertiary	no	Low	yes	yes	unknowr
7	Middle Aged	entrepreneur	divorced	tertiary	yes	Low	yes	no	unknowr
8	old	retired	married	primary	no	Low	yes	no	unknowr
9	Middle Aged	technician	single	secondary	no	Low	yes	no	unknowr
10	Middle Aged	admin.	divorced	secondary	no	Low	yes	no	unknowr
11	Adult	admin.	single	secondary	no	Low	yes	no	unknowr
12	old	technician	married	secondary	no	Low	yes	no	unknowr
13	old	technician	married	unknown	no	Low	yes	no	unknowr
14	old	services	married	secondary	no	Low	yes	no	unknowr
15	old	retired	married	primary	no	Low	yes	no	unknowr
16	Middle Aged	admin.	single	unknown	no	Low	yes	no	unknowr
17	old	blue-collar	married	primary	no	Low	yes	no	unknowr
18	old	retired	married	primary	no	Low	yes	no	unknowr
19	Middle Aged	services	married	secondary	no	Low	yes	no	unknowr
20	Adult	blue-collar	married	secondary	no	Low	yes	yes	unknowr
21	old	management	married	tertiary	no	Low	yes	no	unknowr
22	Middle Aged	blue-collar	single	primary	no	Low	yes	yes	unknowr
23	Adult	services	married	secondary	no	Low	yes	no	unknowr
24	Middle Aged	retired	married	primary	no	Low	yes	yes	unknowr
25	Middle Aged	admin.	married	secondary	no	Negative	yes	no	unknowr
26	Middle Aged	management	single	tertiary	no	Low	yes	no	unknowr
27	old	entrepreneur	married	secondary	no	Low	yes	yes	unknowr

	age	job	marital	education	default	balance	housing	loan	contact
28	Middle Aged	management	single	secondary	no	Negative	yes	no	unknowr
29	Middle Aged	technician	single	secondary	no	Low	yes	yes	unknowr
...	...	...	...	...	...	...	...	...	..
45181	Middle Aged	blue-collar	married	secondary	no	High	no	no	cellular
45182	Middle Aged	technician	married	secondary	no	Low	no	no	cellular
45183	old	retired	married	primary	no	Low	no	no	cellular
45184	old	retired	married	secondary	no	Average	no	no	cellular
45185	old	services	married	tertiary	no	High	yes	no	cellular
45186	old	unknown	married	unknown	no	Average	no	no	cellular
45187	Middle Aged	services	single	secondary	no	Low	yes	no	cellular
45188	Adult	management	single	secondary	no	Low	yes	no	cellular
45189	Adult	services	single	secondary	no	Low	no	no	cellular
45190	Middle Aged	blue-collar	married	secondary	no	Low	no	no	cellular
45191	old	retired	divorced	tertiary	no	High	yes	no	cellular
45192	Adult	management	single	tertiary	no	Low	no	no	cellular
45193	Adult	self-employed	single	tertiary	no	Low	no	no	cellular
45194	old	management	married	tertiary	no	Low	yes	yes	cellular
45195	old	retired	married	secondary	no	Low	no	no	cellular
45196	Adult	student	single	secondary	no	Low	no	no	cellular
45197	Middle Aged	management	single	secondary	no	High	yes	no	cellular
45198	Middle Aged	management	married	tertiary	no	Average	no	no	cellular
45199	Middle Aged	blue-collar	single	secondary	no	Average	yes	no	cellular
45200	Middle Aged	technician	married	secondary	no	Low	yes	no	cellular
45201	old	management	married	tertiary	no	Low	no	no	cellular
45202	Middle Aged	admin.	single	secondary	no	Low	no	no	cellular

	age	job	marital	education	default	balance	housing	loan	contact
45203	Adult	student	single	tertiary	no	Low	no	no	cellular
45204	old	retired	married	secondary	no	High	no	no	cellular
45205	Adult	technician	single	secondary	no	Low	no	yes	cellular
45206	old	technician	married	tertiary	no	Low	no	no	cellular
45207	old	retired	divorced	primary	no	High	no	no	cellular
45208	old	retired	married	secondary	no	High	no	no	cellular

1. Min-Max Normalization

In [46]:
```
data['duration2']  = (data.duration - data.duration.min()) / (data.duration.max() - data.duration.min())
```

In [47]:
```
data.duration2=data.duration2.round(2)
```

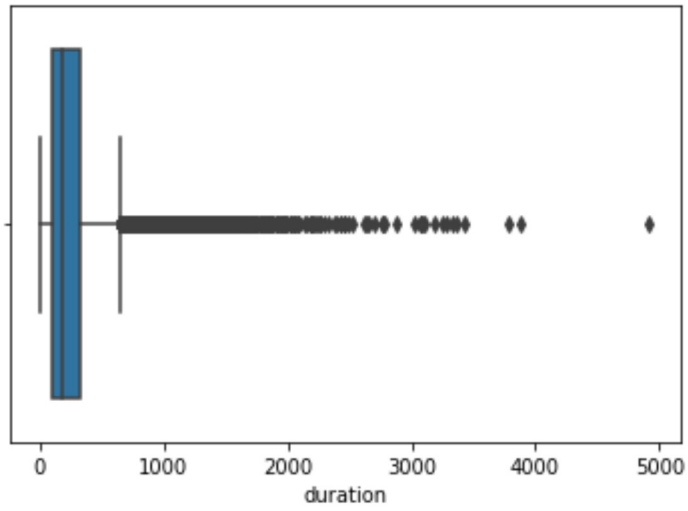
In [48]:
```
data.head()
```

Out[48]:

	age	job	marital	education	default	balance	housing	loan	contact	
0	old	management	married	tertiary	no	High	yes	no	unknown	Betw
1	Middle Aged	technician	single	secondary	no	Low	yes	no	unknown	Betw
2	Middle Aged	entrepreneur	married	secondary	no	Low	yes	yes	unknown	Betw
3	Middle Aged	blue-collar	married	unknown	no	High	yes	no	unknown	Betw
4	Middle Aged	unknown	single	unknown	no	Low	no	no	unknown	Betw

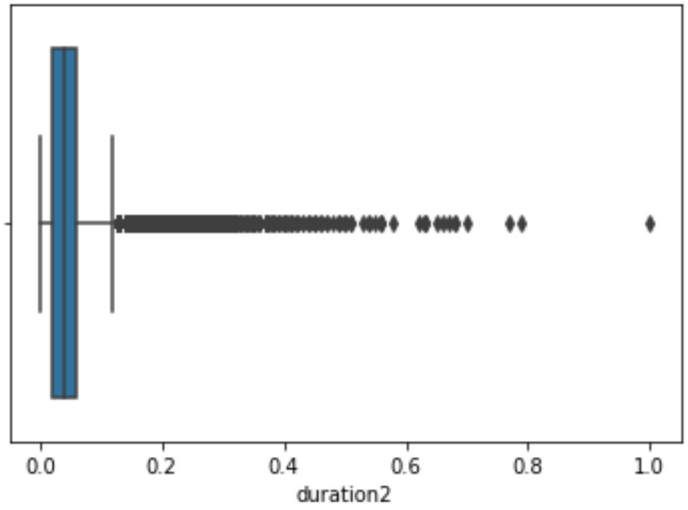
In [49]:
```
sns.boxplot(x='duration',data=data)
```

Out[49]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x2577fa6c2b0>
```



In [50]:
```
sns.boxplot(x='duration2',data=data)
```

Out[50]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x2570875a588>
```



using MinMaxScaler function

In [91]:
```
from sklearn.preprocessing import MinMaxScaler
scaler = MinMaxScaler()
data['durationMinMAx']=scaler.fit_transform(data[['duration']])
```

In [95]:
```
pd.set_option('display.max_columns', 30)
```

In [96]:
```
data.head()
```

Out[96]:

	age	job	marital	education	default	balance	housing	contact	day	mont
0	old	4	married	tertiary	no	High	yes	unknown	Between5-10	
1	Middle Aged	9	single	secondary	no	Low	yes	unknown	Between5-10	
2	Middle Aged	2	married	secondary	no	Low	yes	unknown	Between5-10	
3	Middle Aged	1	married	unknown	no	High	yes	unknown	Between5-10	
4	Middle Aged	11	single	unknown	no	Low	no	unknown	Between5-10	

2. Z-Score Normalization

In [51]:
```
data['duration3'] = (data.duration - data.duration.mean()) / data.du
ration.std()
data.duration3=data.duration3.round(2)
```

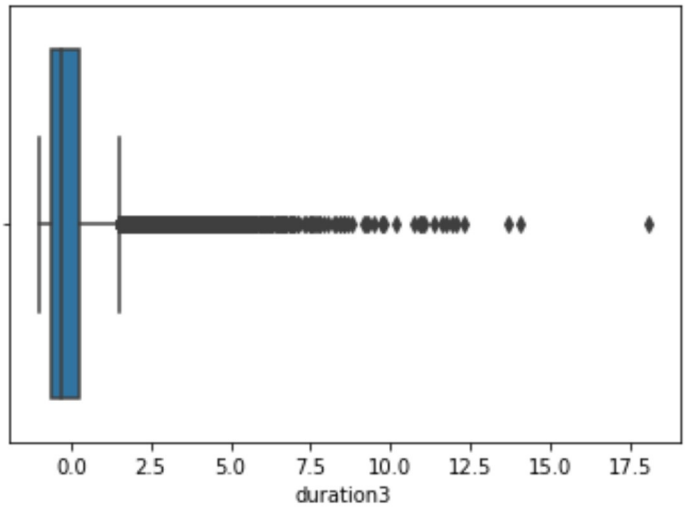
In [52]:
```
data.head()
```

Out[52]:

	age	job	marital	education	default	balance	housing	loan	contact	
0	old	management	married	tertiary	no	High	yes	no	unknown	Betw
1	Middle Aged	technician	single	secondary	no	Low	yes	no	unknown	Betw
2	Middle Aged	entrepreneur	married	secondary	no	Low	yes	yes	unknown	Betw
3	Middle Aged	blue-collar	married	unknown	no	High	yes	no	unknown	Betw
4	Middle Aged	unknown	single	unknown	no	Low	no	no	unknown	Betw

In [53]:
```
sns.boxplot(x='duration3',data=data)
```

Out[53]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x2570875aa90>
```



3. Decimal Scaling

In [54]:
```
maxi=data.duration.max()
```

In [55]:
```
maxi
```

Out[55]:
```
4918
```

In [56]:
```
len(str(maxi))
```

Out[56]:
```
4
```

In [57]:
```
pow(10,4)
```

Out[57]:
```
10000
```

In [58]:
```
data['duration4']=data.duration / pow(10,len(str(data.duration.max
()))))
```

In [59]:
```
data.head()
```

Out[59]:

	age	job	marital	education	default	balance	housing	loan	contact	
0	old	management	married	tertiary	no	High	yes	no	unknown	Betw
1	Middle Aged	technician	single	secondary	no	Low	yes	no	unknown	Betw
2	Middle Aged	entrepreneur	married	secondary	no	Low	yes	yes	unknown	Betw
3	Middle Aged	blue-collar	married	unknown	no	High	yes	no	unknown	Betw
4	Middle Aged	unknown	single	unknown	no	Low	no	no	unknown	Betw

Choosing one Normalization and dropping all others

In [60]:
```
data['duration'] = (data.duration - data.duration.mean()) / data.dur
ation.std()
data.duration=data.duration.round(2)
```

In [61]:
```
data.head()
```

Out[61]:

	age	job	marital	education	default	balance	housing	loan	contact	
0	old	management	married	tertiary	no	High	yes	no	unknown	Betw
1	Middle Aged	technician	single	secondary	no	Low	yes	no	unknown	Betw
2	Middle Aged	entrepreneur	married	secondary	no	Low	yes	yes	unknown	Betw
3	Middle Aged	blue-collar	married	unknown	no	High	yes	no	unknown	Betw
4	Middle Aged	unknown	single	unknown	no	Low	no	no	unknown	Betw

In [63]:
```
data = data.drop(['duration2', 'duration3','duration4'],axis=1)
```

In [239]:
```
data.head()
```

Out[239]:

	age	job	marital	education	default	balance	housing	loan	contact	
0	old	management	married	tertiary	no	High	yes	no	unknown	Betw
1	Middle Aged	technician	single	secondary	no	Low	yes	no	unknown	Betw
2	Middle Aged	entrepreneur	married	secondary	no	Low	yes	yes	unknown	Betw
3	Middle Aged	blue-collar	married	unknown	no	High	yes	no	unknown	Betw
4	Middle Aged	unknown	single	unknown	no	Low	no	no	unknown	Betw

5. Feature Encoding

a) Mannual Encoding

In [65]:
```
data['marital'].value_counts()
```

Out[65]:
```
married     27214
single      12790
divorced     5207
Name: marital, dtype: int64
```

In [66]:
```
data['marital2'] = data['marital'].replace(['married','single','divo
rced'],[0,1,2])
```

In [67]:
```
data.head()
```

Out[67]:

	age	job	marital	education	default	balance	housing	loan	contact	
0	old	management	married	tertiary	no	High	yes	no	unknown	Betw
1	Middle Aged	technician	single	secondary	no	Low	yes	no	unknown	Betw
2	Middle Aged	entrepreneur	married	secondary	no	Low	yes	yes	unknown	Betw
3	Middle Aged	blue-collar	married	unknown	no	High	yes	no	unknown	Betw
4	Middle Aged	unknown	single	unknown	no	Low	no	no	unknown	Betw

b) Encoding Ordinal Attributes

In [69]:
```
data['balance'].value_counts()
```

Out[69]:
```
Low          28487
High         10843
Negative      3766
Average       2063
very high       52
Name: balance, dtype: int64
```

In [70]:
```
data['balance2'] = data['balance'].replace(['Negative','Low','Averag
e','High','very high'],[0,1,2,3,4])
```

In [71]:
```
data.head()
```

Out[71]:

	age	job	marital	education	default	balance	housing	loan	contact	
0	old	management	married	tertiary	no	High	yes	no	unknown	Betw
1	Middle Aged	technician	single	secondary	no	Low	yes	no	unknown	Betw
2	Middle Aged	entrepreneur	married	secondary	no	Low	yes	yes	unknown	Betw
3	Middle Aged	blue-collar	married	unknown	no	High	yes	no	unknown	Betw
4	Middle Aged	unknown	single	unknown	no	Low	no	no	unknown	Betw

c) Label Encoding

In [72]:
```
data['month'].value_counts()
```

Out[72]:
```
may    13766
jul     6895
aug     6247
jun     5341
nov     3970
apr     2932
feb     2649
jan     1403
oct      738
sep      579
mar      477
dec      214
Name: month, dtype: int64
```

In [73]:
```
from numpy import array
from sklearn.preprocessing import LabelEncoder
```

In [74]:
```
label_encoder = LabelEncoder()
data.month = label_encoder.fit_transform(data.month)
data.head()
```

Out[74]:

	age	job	marital	education	default	balance	housing	loan	contact	
0	old	management	married	tertiary	no	High	yes	no	unknown	Betw
1	Middle Aged	technician	single	secondary	no	Low	yes	no	unknown	Betw
2	Middle Aged	entrepreneur	married	secondary	no	Low	yes	yes	unknown	Betw
3	Middle Aged	blue-collar	married	unknown	no	High	yes	no	unknown	Betw
4	Middle Aged	unknown	single	unknown	no	Low	no	no	unknown	Betw

In [76]:
```
data['month'].value_counts()
```

Out[76]:
```
8     13766
5      6895
1      6247
6      5341
9      3970
0      2932
3      2649
4      1403
10      738
11      579
7       477
2       214
Name: month, dtype: int64
```

In [75]:
```
data['month'].value_counts()
```

Out[75]:
```
8     13766
5      6895
1      6247
6      5341
9      3970
0      2932
3      2649
4      1403
10      738
11      579
7       477
2       214
Name: month, dtype: int64
```

In [77]:
```
data['job'].value_counts()
```

Out[77]:
```
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: job, dtype: int64
```

In [78]:
```
label_encoder = LabelEncoder()
data.job = label_encoder.fit_transform(data.job)
data.head()
```

Out[78]:

	age	job	marital	education	default	balance	housing	loan	contact	day
0	old	4	married	tertiary	no	High	yes	no	unknown	Between5-10
1	Middle Aged	9	single	secondary	no	Low	yes	no	unknown	Between5-10
2	Middle Aged	2	married	secondary	no	Low	yes	yes	unknown	Between5-10
3	Middle Aged	1	married	unknown	no	High	yes	no	unknown	Between5-10
4	Middle Aged	11	single	unknown	no	Low	no	no	unknown	Between5-10

6. ONE HOT ENCODING

In [260]:
```
data['loan'].value_counts()
```

Out[260]:
```
no     37967
yes     7244
Name: loan, dtype: int64
```

In [265]:
```
data.dtypes
```

Out[265]:
```
age            object
job             int64
marital        object
education      object
default        object
balance        object
housing        object
loan         category
contact        object
day            object
month           int64
duration      float64
campaign        int64
pdays           int64
previous        int64
poutcome       object
y              object
marital2        int64
balance2        int64
dtype: object
```

In [79]:
```
data['loan'] = pd.Categorical(data['loan'])
```

In [80]:
```
    dfDummies = pd.get_dummies(data['loan'], prefix = 'loan')
```

In [81]:
```
dfDummies
```

Out[81]:

	loan_no	loan_yes
0	1	0
1	1	0
2	0	1
3	1	0
4	1	0
...	...	...
45206	1	0
45207	1	0
45208	1	0
45209	1	0
45210	1	0

45211 rows × 2 columns

In [82]:
```
data = pd.concat([data, dfDummies], axis=1)
```

In [83]:
```
data.head()
```

Out[83]:

	age	job	marital	education	default	balance	housing	loan	contact	day
0	old	4	married	tertiary	no	High	yes	no	unknown	Between5-10
1	Middle Aged	9	single	secondary	no	Low	yes	no	unknown	Between5-10
2	Middle Aged	2	married	secondary	no	Low	yes	yes	unknown	Between5-10
3	Middle Aged	1	married	unknown	no	High	yes	no	unknown	Between5-10
4	Middle Aged	11	single	unknown	no	Low	no	no	unknown	Between5-10

5 rows × 21 columns

In [84]:
```
del data['loan']
```

In [85]:
```
data.head()
```

Out[85]:

	age	job	marital	education	default	balance	housing	contact	day	mont
0	old	4	married	tertiary	no	High	yes	unknown	Between5-10	
1	Middle Aged	9	single	secondary	no	Low	yes	unknown	Between5-10	
2	Middle Aged	2	married	secondary	no	Low	yes	unknown	Between5-10	
3	Middle Aged	1	married	unknown	no	High	yes	unknown	Between5-10	
4	Middle Aged	11	single	unknown	no	Low	no	unknown	Between5-10	

In [ ]: