Telecom Customer Churn Analysis ¶

1. Domain Exploration
    - understand the business process
    - Identify beleifs, loopholes, losses, data flow in the business flow

1. Data Collection & data exploration
    - Collecting data from different business verticals, preparing a dataset out of it
    - explore data for common challenges and data quality issues.

1. Data Cleaning
    - Handling missing values
    - Handling unwanted columns - identifiers
    - Handling duplicate entries
    - Handling outliers

1. Descriptive & Exploratory Analysis
    - Statistics
    - Data Visualization

1. Preparing the report

Data Exploration

In [2]:

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

In [3]:

```
#Load data
df = pd.read_excel(r"E:\MLIoT\ML\dataset\telecom\telecom_churn_modelling.xlsx")
df.shape
```

Out[3]:

```
(3333, 20)
```

In [4]:

```
df.head()
```

Out[4]:

	State	Account length	Area code	International plan	Voice mail plan	Number vmail messages	Total day minutes	Total day calls	Total day charge	Total eve minutes	T
0	KS	128	415	No	Yes	25	265.1	110	45.07	197.4	
1	OH	107	415	No	Yes	26	161.6	123	27.47	195.5	
2	NJ	137	415	No	No	0	243.4	114	41.38	121.2	
3	OH	84	408	Yes	No	0	299.4	71	50.90	61.9	
4	OK	75	415	Yes	No	0	166.7	113	28.34	148.3	

In [5]:

```
len(df['State'].unique())
```

Out[5]:

```
51
```

In [6]:

```
df['Area code'].unique()
```

Out[6]:

```
array([415, 408, 510], dtype=int64)
```

Observations -

```
- unwanted columns - State may be an identifier and may not be needed, Area code
- Customer having no voice mail plan will have the value of number of vmail mess
ages as 0
- mostly total xxx minutes should be highly correlated to total xxx charge
```

In [7]:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 3333 entries, 0 to 3332
Data columns (total 20 columns):
 #   Column                  Non-Null Count  Dtype  
---  ------                  --------------  -----  
 0   State                   3333 non-null   object 
 1   Account length          3333 non-null   int64  
 2   Area code               3333 non-null   int64  
 3   International plan      3333 non-null   object 
 4   Voice mail plan         3333 non-null   object 
 5   Number vmail messages   3333 non-null   int64  
 6   Total day minutes       3333 non-null   float64
 7   Total day calls         3333 non-null   int64  
 8   Total day charge        3333 non-null   float64
 9   Total eve minutes       3333 non-null   float64
 10  Total eve calls         3333 non-null   int64  
 11  Total eve charge        3333 non-null   float64
 12  Total night minutes     3333 non-null   float64
 13  Total night calls       3333 non-null   int64  
 14  Total night charge      3333 non-null   float64
 15  Total intl minutes      3333 non-null   float64
 16  Total intl calls        3333 non-null   int64  
 17  Total intl charge       3333 non-null   float64
 18  Customer service calls  3333 non-null   int64  
 19  Churn                   3333 non-null   bool   
dtypes: bool(1), float64(8), int64(8), object(3)
memory usage: 498.1+ KB
```

In [8]:

```
df['State'].unique()
```

Out[8]:

```
array(['KS', 'OH', 'NJ', 'OK', 'AL', 'MA', 'MO', 'LA', 'WV', 'IN', 'RI',
       'IA', 'MT', 'NY', 'ID', 'VT', 'VA', 'TX', 'FL', 'CO', 'AZ', 'SC',
       'NE', 'WY', 'HI', 'IL', 'NH', 'GA', 'AK', 'MD', 'AR', 'WI', 'OR',
       'MI', 'DE', 'UT', 'CA', 'MN', 'SD', 'NC', 'WA', 'NM', 'NV', 'DC',
       'KY', 'ME', 'MS', 'TN', 'PA', 'CT', 'ND'], dtype=object)
```

In [9]:

```
df['International plan'].unique()
```

Out[9]:

```
array(['No', 'Yes'], dtype=object)
```

In [10]:

```
df['Voice mail plan'].unique()
```

Out[10]:

```
array(['Yes', 'No'], dtype=object)
```

Data Cleaning

In [11]:

```
# check for duplicated rows
df.duplicated().sum()
```

Out[11]:

```
0
```

In [12]:

```
# check for missng values
df.isnull().sum()
```

Out[12]:

```
State                     0
Account length            0
Area code                 0
International plan        0
Voice mail plan           0
Number vmail messages     0
Total day minutes         0
Total day calls           0
Total day charge          0
Total eve minutes         0
Total eve calls           0
Total eve charge          0
Total night minutes       0
Total night calls         0
Total night charge        0
Total intl minutes        0
Total intl calls          0
Total intl charge         0
Customer service calls    0
Churn                     0
dtype: int64
```

In [13]:

```
# Dropping unwanted columns
# - analyse the categorical columns
```

In [14]:

```
# check for outliers
df.skew()
```

Out[14]:

```
Account length            0.096606
Area code                 1.126823
Number vmail messages     1.264824
Total day minutes        -0.029077
Total day calls          -0.111787
Total day charge         -0.029083
Total eve minutes        -0.023877
Total eve calls          -0.055563
Total eve charge         -0.023858
Total night minutes       0.008921
Total night calls         0.032500
Total night charge        0.008886
Total intl minutes       -0.245136
Total intl calls          1.321478
Total intl charge        -0.245287
Customer service calls    1.091359
Churn                     2.018356
dtype: float64
```

Descriptive Analysis

In [15]:

```
df.head()
```

Out[15]:

	State	Account length	Area code	International plan	Voice mail plan	Number vmail messages	Total day minutes	Total day calls	Total day charge	Total eve minutes	T
0	KS	128	415	No	Yes	25	265.1	110	45.07	197.4	
1	OH	107	415	No	Yes	26	161.6	123	27.47	195.5	
2	NJ	137	415	No	No	0	243.4	114	41.38	121.2	
3	OH	84	408	Yes	No	0	299.4	71	50.90	61.9	
4	OK	75	415	Yes	No	0	166.7	113	28.34	148.3	

State

In [16]:

```
df['State'].value_counts()
```

Out[16]:

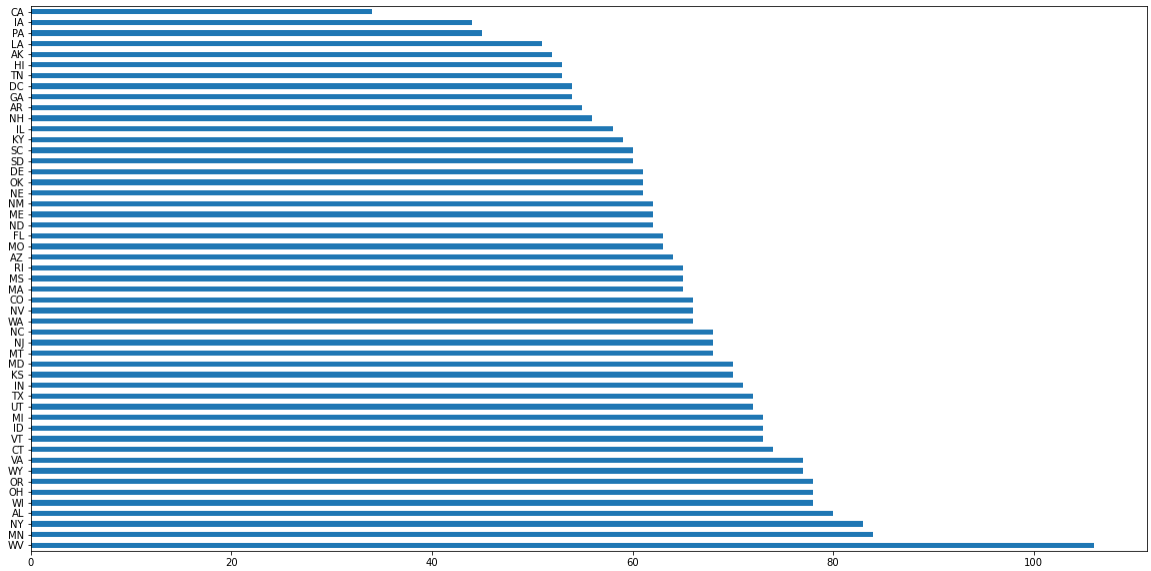
```
WV    106
MN     84
NY     83
AL     80
WI     78
OH     78
OR     78
WY     77
VA     77
CT     74
VT     73
ID     73
MI     73
UT     72
TX     72
IN     71
KS     70
MD     70
MT     68
NJ     68
NC     68
WA     66
NV     66
CO     66
MA     65
MS     65
RI     65
AZ     64
MO     63
FL     63
ND     62
ME     62
NM     62
NE     61
OK     61
DE     61
SD     60
SC     60
KY     59
IL     58
NH     56
AR     55
GA     54
DC     54
TN     53
HI     53
AK     52
LA     51
PA     45
IA     44
CA     34
Name: State, dtype: int64
```

In [19]:

```
df['State'].value_counts().plot(kind='barh',figsize=(20,10))
```

Out[19]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x2a4cecb4288>
```



Observation -

- the number of customers from each state is differently distributed

In [21]:

```
df.columns
```

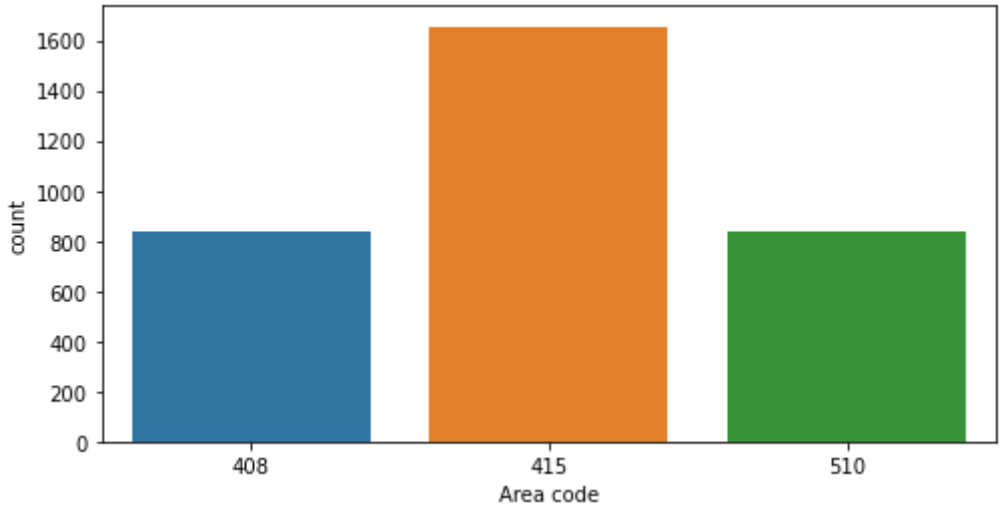
Out[21]:

```
Index(['State', 'Account length', 'Area code', 'International plan',
       'Voice mail plan', 'Number vmail messages', 'Total day minutes',
       'Total day calls', 'Total day charge', 'Total eve minutes',
       'Total eve calls', 'Total eve charge', 'Total night minutes',
       'Total night calls', 'Total night charge', 'Total intl minutes',
       'Total intl calls', 'Total intl charge', 'Customer service calls',
       'Churn'],
      dtype='object')
```

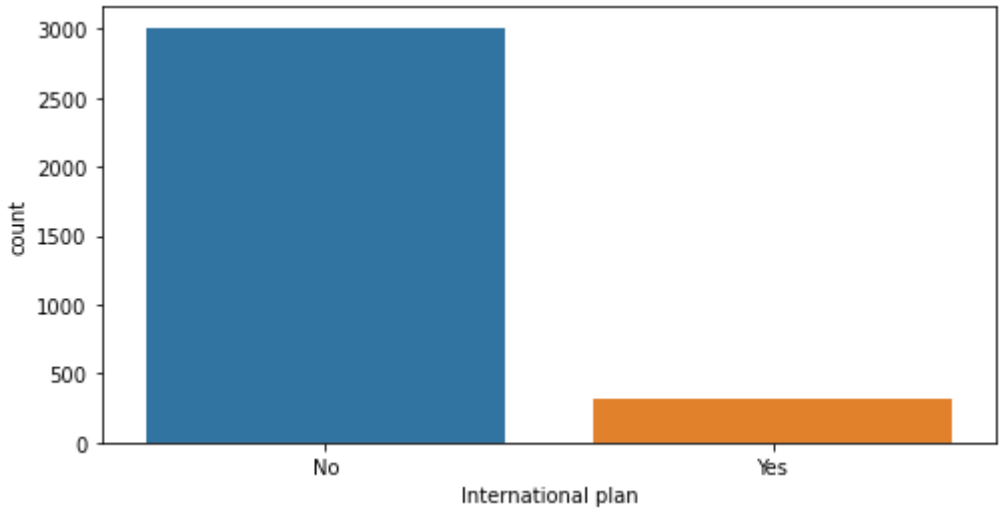
In [22]:

```
cats = ['Area code', 'International plan','Voice mail plan','Churn']
for col in cats:
    print(df[col].value_counts())

    plt.figure(figsize=(8,4))
    sns.countplot(df[col])
    plt.show()
```

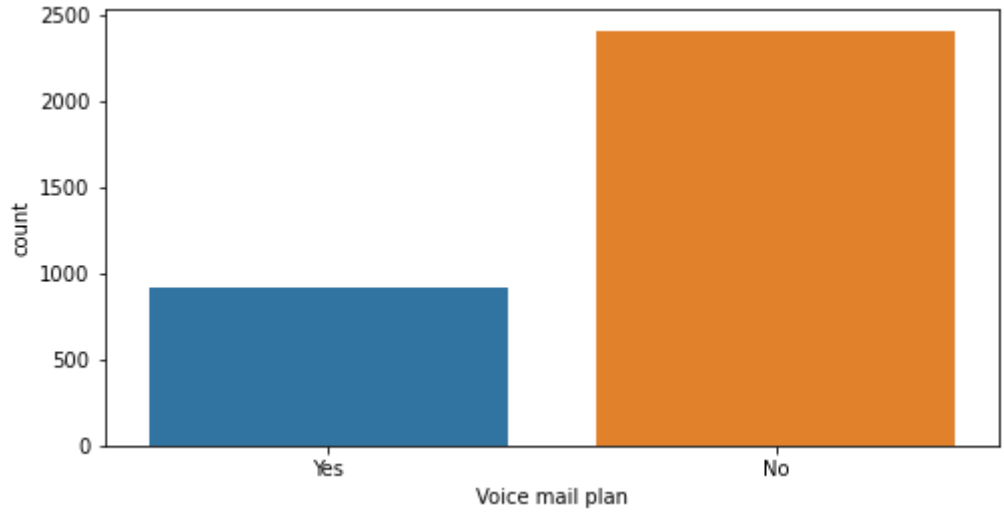
```
415    1655
510     840
408     838
Name: Area code, dtype: int64
```



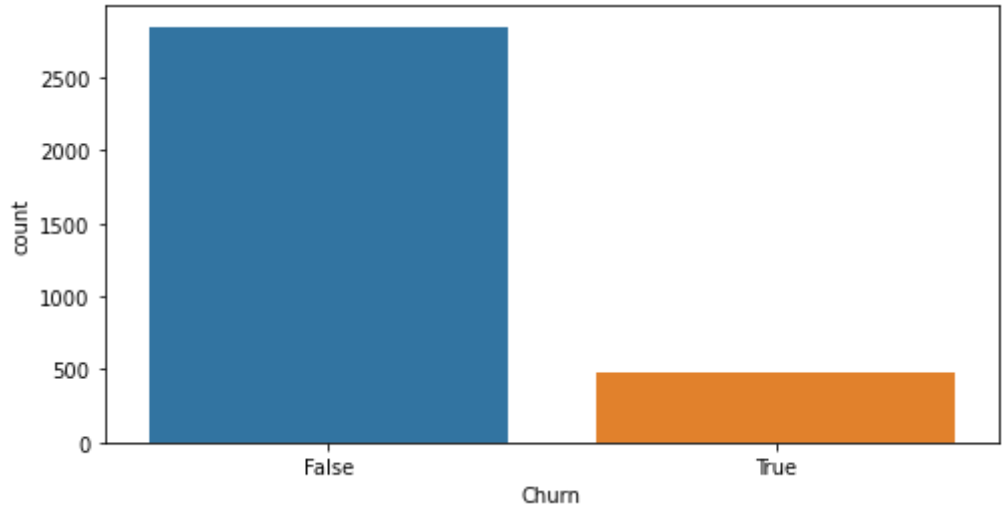

```
No     3010
Yes     323
Name: International plan, dtype: int64
```




```
No     2411
Yes     922
Name: Voice mail plan, dtype: int64
```




```
False    2850
True      483
Name: Churn, dtype: int64
```



Observations -

- Area code - almost half of customers are from area code 415, 1/4 from other two area code each
- Internation Plan - almost 90% of customers do not have internation plan
- Voice mail Message - almost 30% of customers have opted for voice mail message
- Churn - alomst 14% of cusomers left the telecom company

Numeric variables

In [23]:

```
df.describe()
```

Out[23]:

	Account length	Area code	Number vmail messages	Total day minutes	Total day calls	Total day charge	To m
count	3333.000000	3333.000000	3333.000000	3333.000000	3333.000000	3333.000000	3333.(
mean	101.064806	437.182418	8.099010	179.775098	100.435644	30.562307	200.9
std	39.822106	42.371290	13.688365	54.467389	20.069084	9.259435	50.1
min	1.000000	408.000000	0.000000	0.000000	0.000000	0.000000	0.(
25%	74.000000	408.000000	0.000000	143.700000	87.000000	24.430000	166.(
50%	101.000000	415.000000	0.000000	179.400000	101.000000	30.500000	201.4
75%	127.000000	510.000000	20.000000	216.400000	114.000000	36.790000	235.3
max	243.000000	510.000000	51.000000	350.800000	165.000000	59.640000	363.1

In [24]:

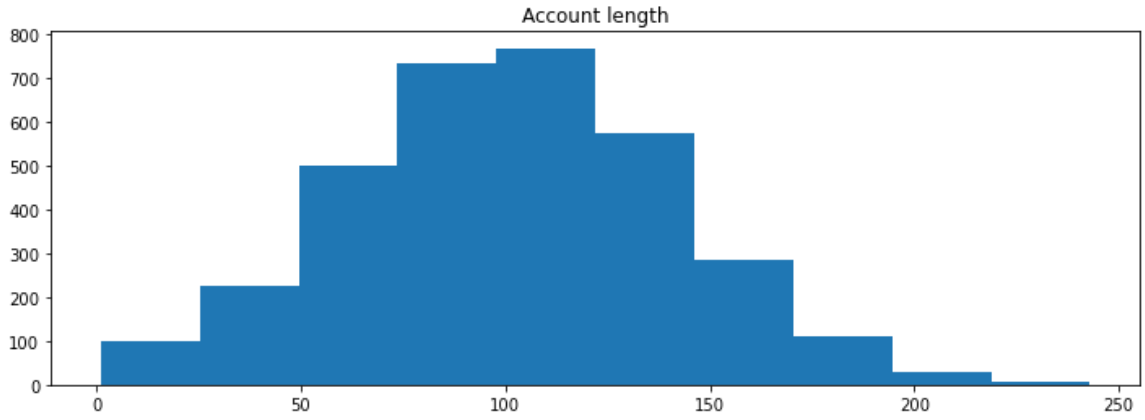
```
df.columns
```

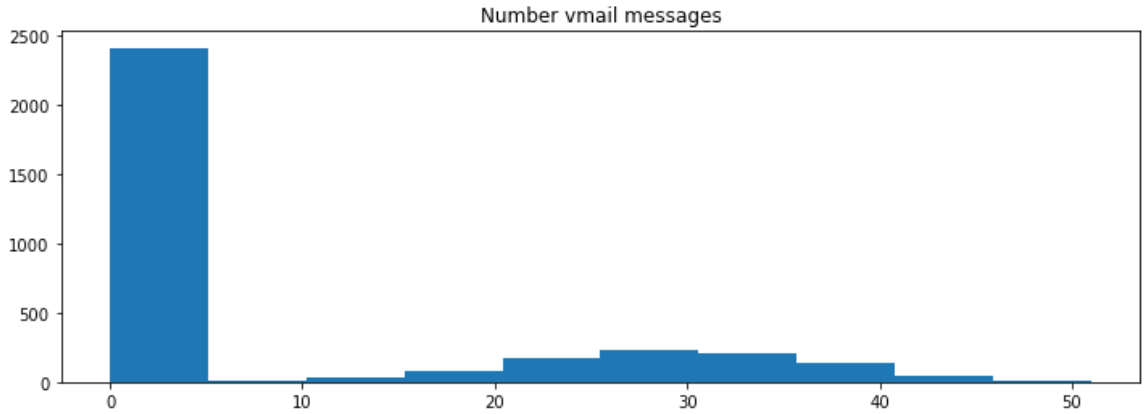
Out[24]:

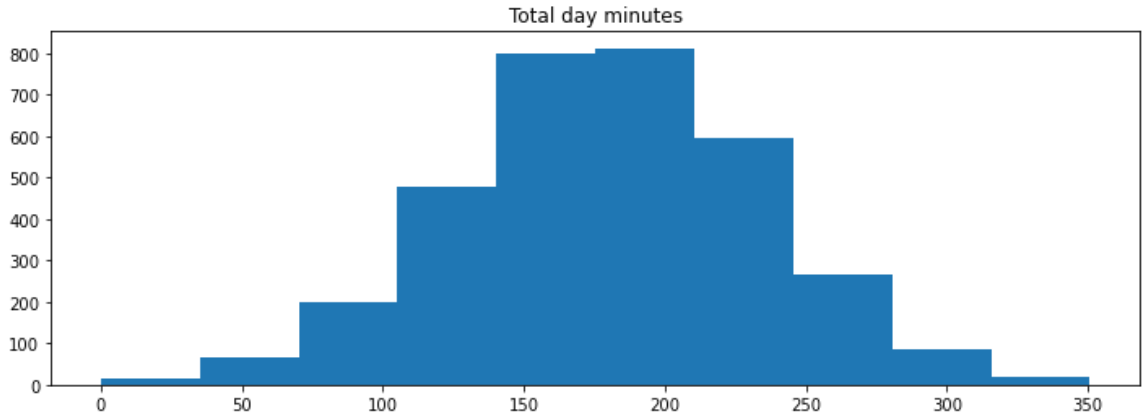
```
Index(['State', 'Account length', 'Area code', 'International plan',
       'Voice mail plan', 'Number vmail messages', 'Total day minutes',
       'Total day calls', 'Total day charge', 'Total eve minutes',
       'Total eve calls', 'Total eve charge', 'Total night minutes',
       'Total night calls', 'Total night charge', 'Total intl minutes',
       'Total intl calls', 'Total intl charge', 'Customer service calls',
       'Churn'],
      dtype='object')
```

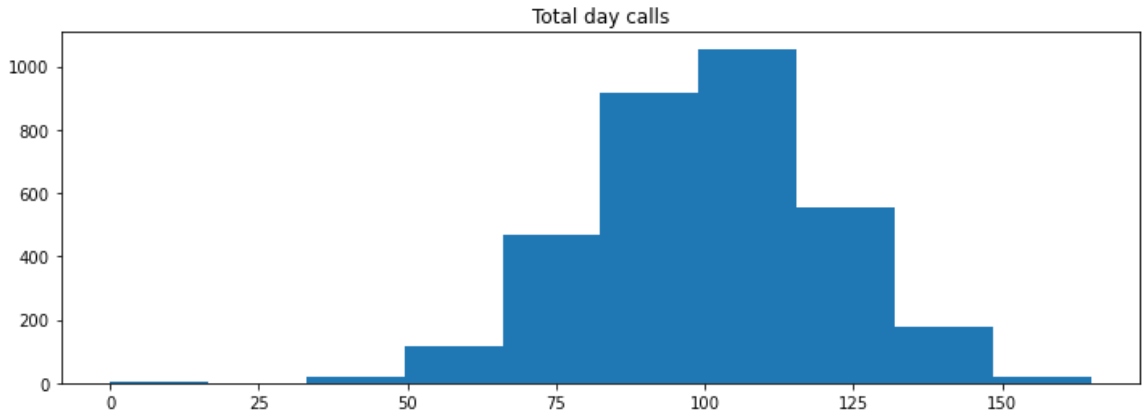
In [28]:

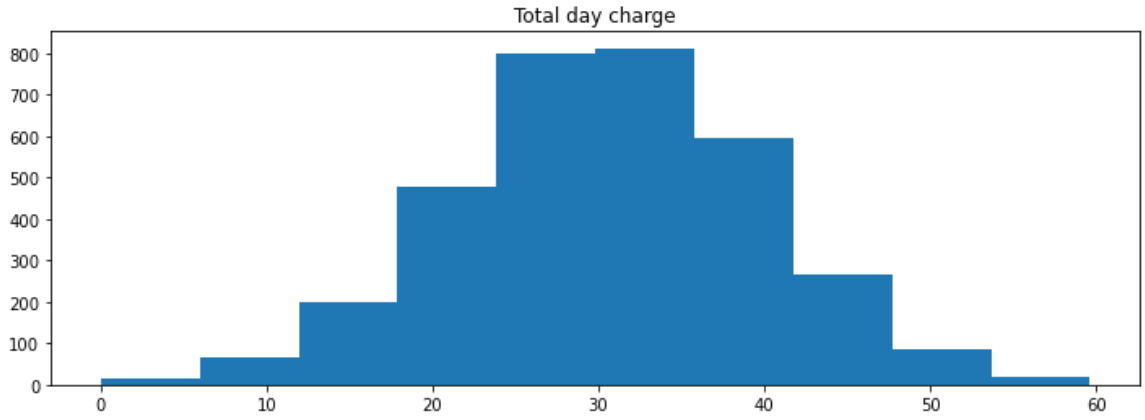
```
nums = ['Account length', 'Number vmail messages', 'Total day minutes',
       'Total day calls', 'Total day charge', 'Total eve minutes',
       'Total eve calls', 'Total eve charge', 'Total night minutes',
       'Total night calls', 'Total night charge', 'Total intl minutes',
       'Total intl calls', 'Total intl charge', 'Customer service calls']

for col in nums:
    plt.figure(figsize=(12,4))
    plt.hist(df[col])
    plt.title(col)
    plt.show()
```

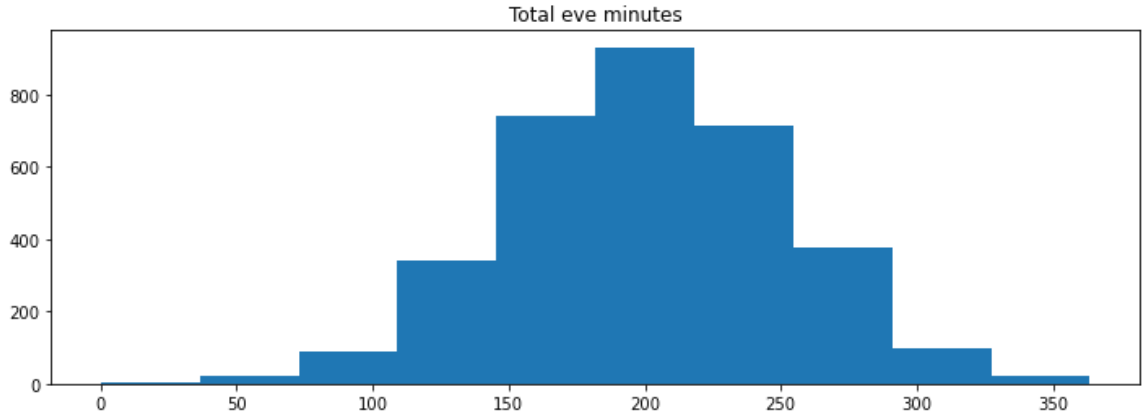

Account length
800
700
600
500
400
300
200
100
0
0
50
100
150
200
250

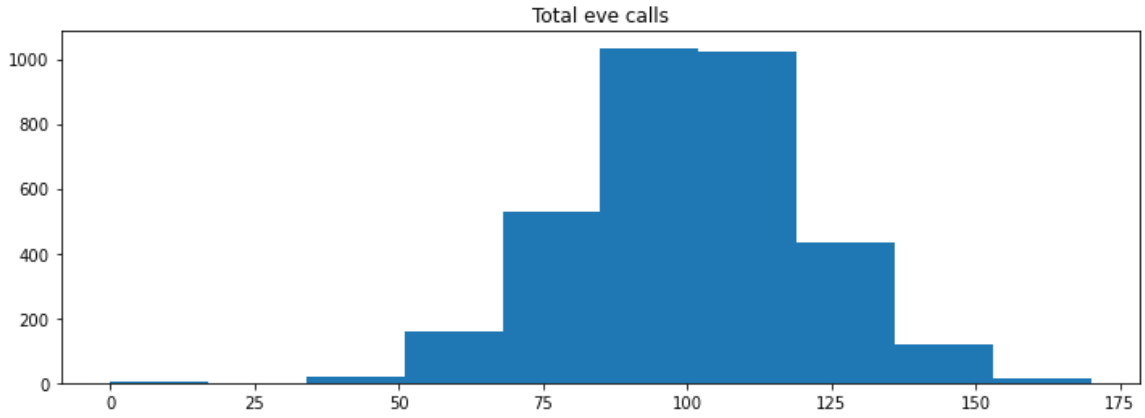

Number vmail messages
2500
2000
1500
1000
500
0
0
10
20
30
40
50

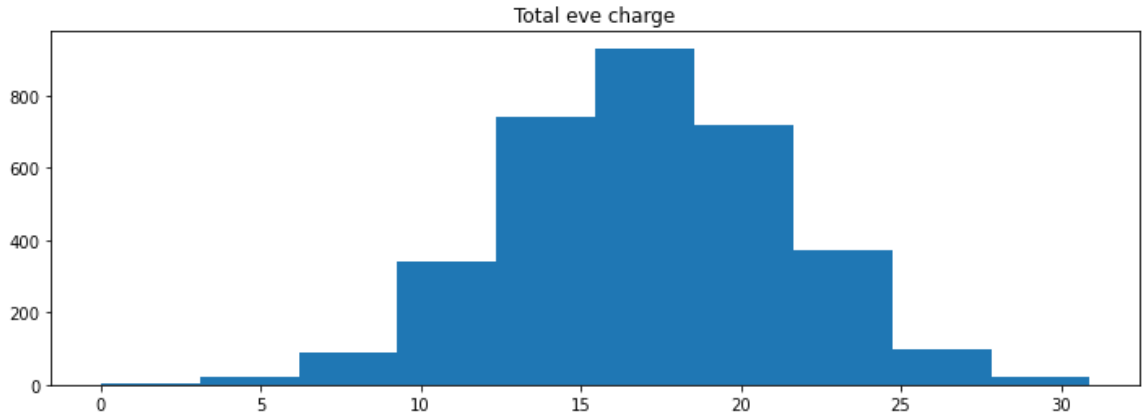

Total day minutes
800
700
600
500
400
300
200
100
0
0
50
100
150
200
250
300
350

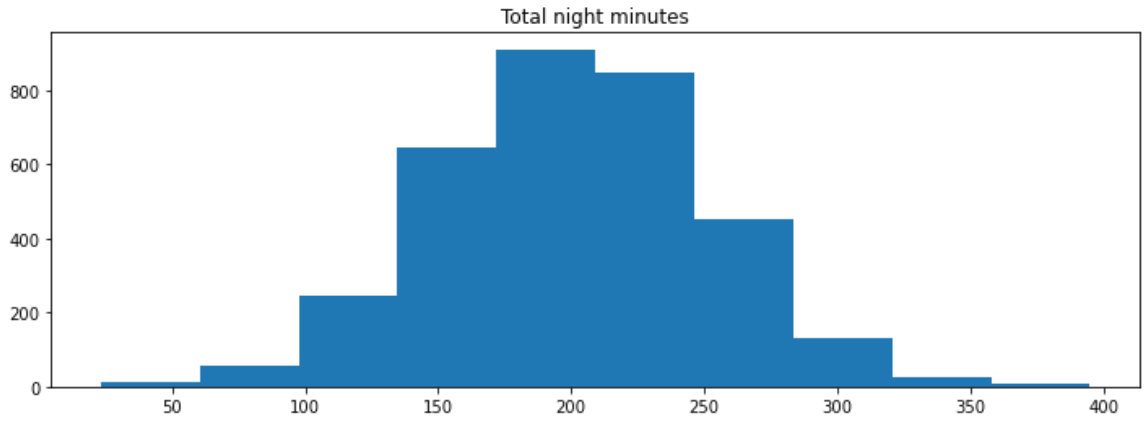

Total day calls
1000
800
600
400
200
0
0
25
50
75
100
125
150

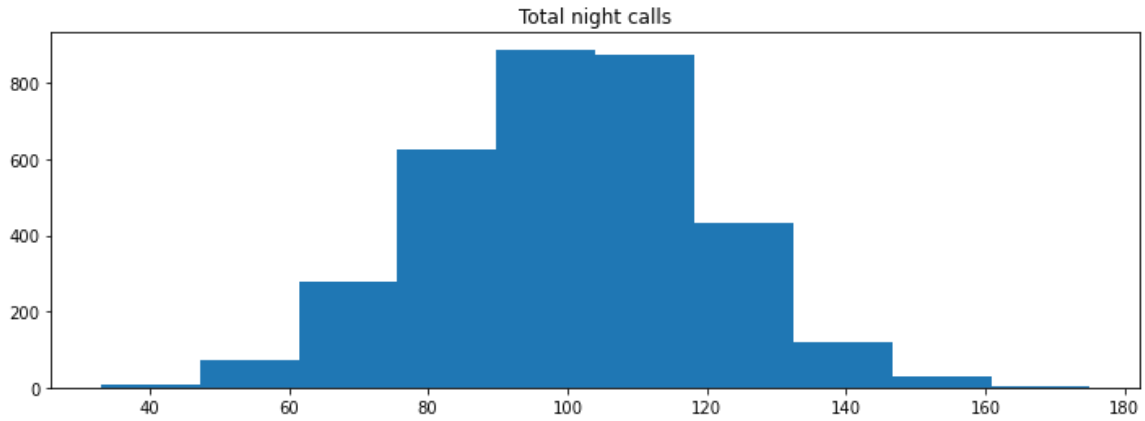

Total day charge
800
700
600
500
400
300
200
100
0
0
10
20
30
40
50
60

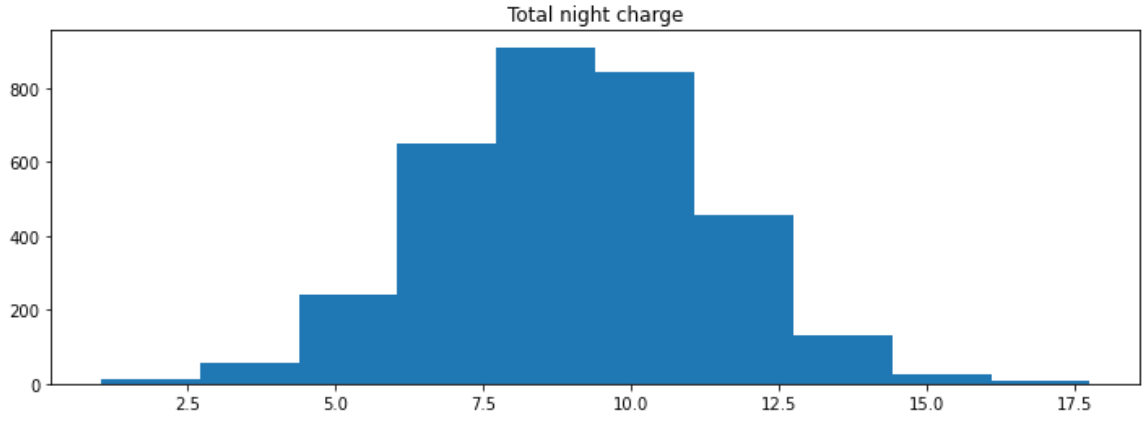

Total eve minutes
800
600
400
200
0
0
50
100
150
200
250
300
350

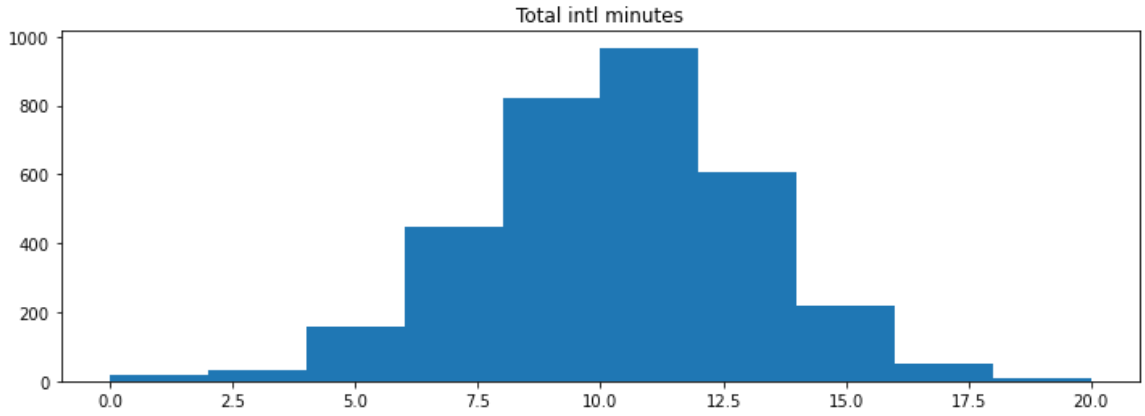

Total eve calls
1000
800
600
400
200
0
0
25
50
75
100
125
150
175

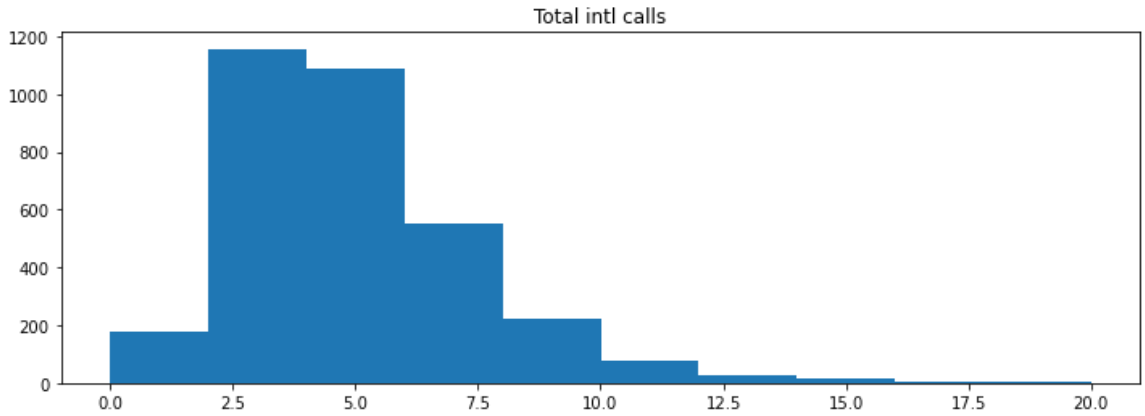

Total eve charge
800
600
400
200
0
0
5
10
15
20
25
30

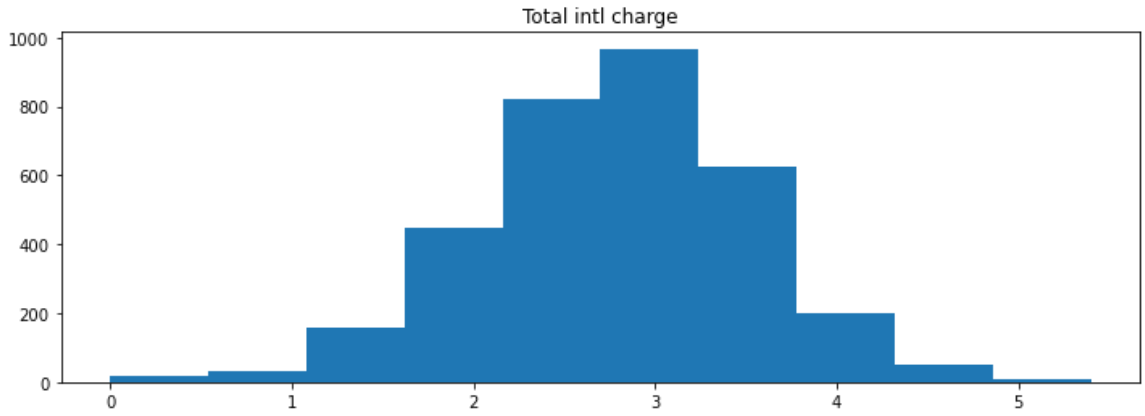

Total night minutes
800
600
400
200
0
50
100
150
200
250
300
350
400

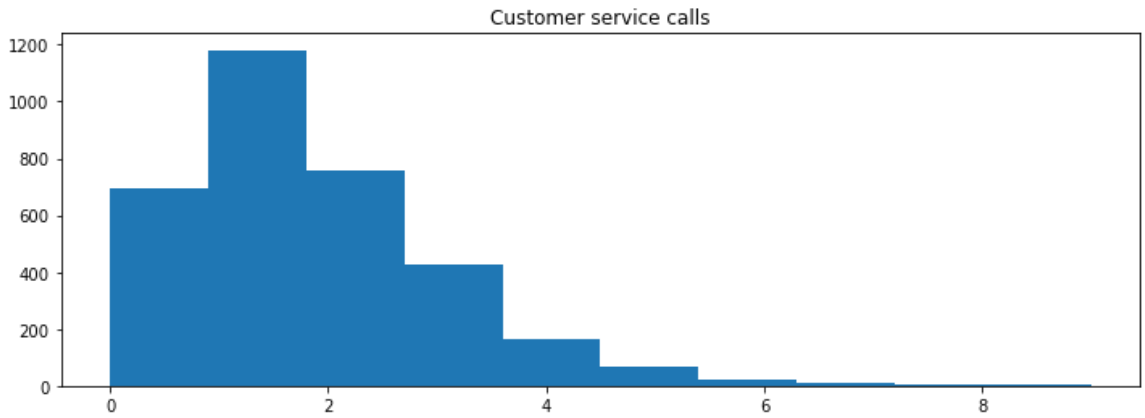

Total night calls
800
600
400
200
0
40
60
80
100
120
140
160
180


Total night charge
800
600
400
200
0
2.5
5.0
7.5
10.0
12.5
15.0
17.5


Total intl minutes
1000
800
600
400
200
0
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0


Total intl calls
1200
1000
800
600
400
200
0
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0


Total intl charge
1000
800
600
400
200
0
0
1
2
3
4
5


Customer service calls
1200
1000
800
600
400
200
0
0
2
4
6
8

In [ ]:

```

```