Preprocessing Training Data

```
import numpy as np
import pandas as pd
import seaborn as sns
df=pd.read_csv('/content/churn-bigml-80.csv')
df
```

	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	Tot e char
0	KS	128	415	No	Yes	25	265.1	110	45.07	197.4	99	16
1	OH	107	415	No	Yes	26	161.6	123	27.47	195.5	103	16
2	NJ	137	415	No	No	0	243.4	114	41.38	121.2	110	10
3	OH	84	408	Yes	No	0	299.4	71	50.90	61.9	88	5
4	OK	75	415	Yes	No	0	166.7	113	28.34	148.3	122	12
...	...	...	...	...	...	...	...	...	...	...	...	
2661	SC	79	415	No	No	0	134.7	98	22.90	189.7	68	16
2662	AZ	192	415	No	Yes	36	156.2	77	26.55	215.5	126	18
2663	WV	68	415	No	No	0	231.1	57	39.29	153.4	55	13
2664	RI	28	510	No	No	0	180.8	109	30.74	288.8	58	24
2665	TN	74	415	No	Yes	25	234.4	113	39.85	265.9	82	22

2666 rows × 20 columns

```
#First 5 observation print
df.head()
```

	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
0	KS	128	415	No	Yes	25	265.1	110	45.07	197.4	99	16.78
1	OH	107	415	No	Yes	26	161.6	123	27.47	195.5	103	16.62
2	NJ	137	415	No	No	0	243.4	114	41.38	121.2	110	10.30
3	OH	84	408	Yes	No	0	299.4	71	50.90	61.9	88	5.26
4	OK	75	415	Yes	No	0	166.7	113	28.34	148.3	122	12.61

```
#Last 5 observation print
df.tail()
```

	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	Tot e char
2661	SC	79	415	No	No	0	134.7	98	22.90	189.7	68	16
2662	AZ	192	415	No	Yes	36	156.2	77	26.55	215.5	126	18
2663	WV	68	415	No	No	0	231.1	57	39.29	153.4	55	13
2664	RI	28	510	No	No	0	180.8	109	30.74	288.8	58	24
2665	TN	74	415	No	Yes	25	234.4	113	39.85	265.9	82	22

```
#Column heading print
df.columns
```

```
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')
```

```
#Each column types
df.dtypes
```

```
State                    object
Account length            int64
Area code                 int64
International plan       object
Voice mail plan          object
Number vmail messages     int64
Total day minutes       float64
Total day calls           int64
Total day charge        float64
Total eve minutes       float64
Total eve calls           int64
Total eve charge        float64
Total night minutes     float64
Total night calls         int64
Total night charge      float64
Total intl minutes      float64
Total intl calls          int64
Total intl charge       float64
Customer service calls    int64
Churn                      bool
dtype: object
```

```
#To find Missing values
df.isna().sum()
```

```
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
```

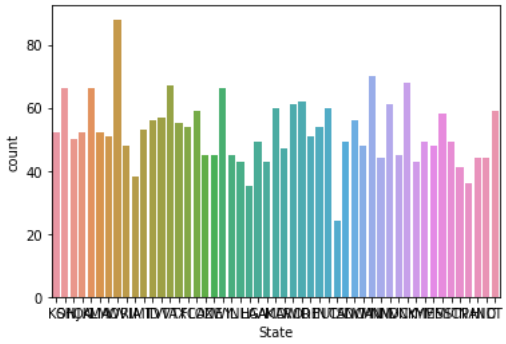
```
#Each state counts
df['State'].value_counts()
```

```
WV    88
MN    70
NY    68
VA    67
AL    66
OH    66
WY    66
OR    62
NV    61
WI    61
MD    60
UT    60
CO    59
CT    59
MI    58
VT    57
ID    56
NC    56
TX    55
FL    54
```

```
IN    54
MT    53
OK    52
MA    52
KS    52
MO    51
DE    51
NJ    50
SC    49
SD    49
ME    49
GA    49
RI    48
MS    48
WA    48
AR    47
IL    45
DC    45
AZ    45
NE    45
HI    44
NM    44
ND    44
AK    43
KY    43
NH    43
TN    41
IA    38
PA    36
LA    35
CA    24
Name: State, dtype: int64
```

```
#Each state count Graph
sns.countplot('State',data=df)
```

```
/usr/local/lib/python3.9/dist-packages/seaborn/_decorators.py:36: FutureWarning: Pass the following var
  warnings.warn(
<AxesSubplot:xlabel='State', ylabel='count'>
```




```
#Each International plan count
df['International plan'].value_counts()
```

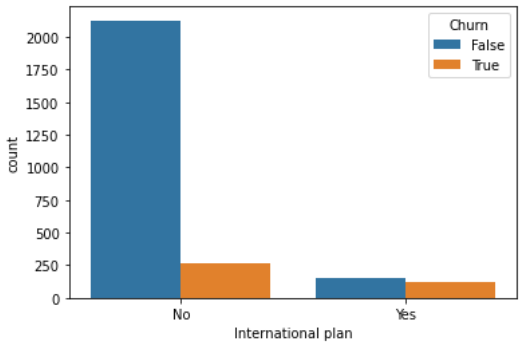
```
No     2396
Yes     270
Name: International plan, dtype: int64
```

```
#Each International plan count graph
sns.countplot('International plan',data=df)
```

```
/usr/local/lib/python3.9/dist-packages/seaborn/_decorators.py:36: FutureWarning: Pass the following var
```

```
#How Each International plan affect Churn graph
sns.countplot('International plan',data=df,hue='Churn')
```

```
/usr/local/lib/python3.9/dist-packages/seaborn/_decorators.py:36: FutureWarning: Pass the following var
  warnings.warn(
<AxesSubplot:xlabel='International plan', ylabel='count'>
```

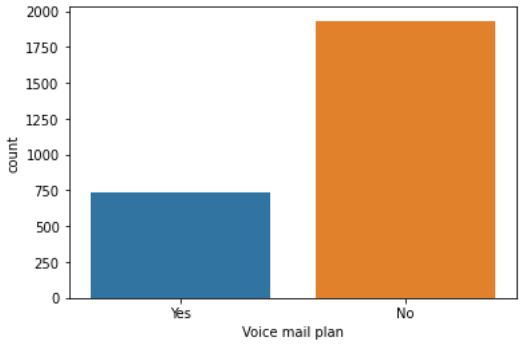



```
#Each voice plan count
df['Voice mail plan'].value_counts()
```

```
No     1933
Yes     733
Name: Voice mail plan, dtype: int64
```

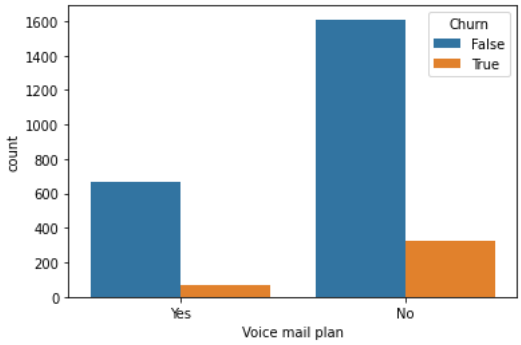
```
#Each voice plan count graph
sns.countplot('Voice mail plan',data=df)
```

```
/usr/local/lib/python3.9/dist-packages/seaborn/_decorators.py:36: FutureWarning: Pass the following var
  warnings.warn(
<AxesSubplot:xlabel='Voice mail plan', ylabel='count'>
```




```
#How Each Voice mail plan affect Churn graph
sns.countplot('Voice mail plan',data=df,hue='Churn')
```

```
/usr/local/lib/python3.9/dist-packages/seaborn/_decorators.py:36: FutureWarning: Pass the following var
  warnings.warn(
<AxesSubplot:xlabel='Voice mail plan', ylabel='count'>
```



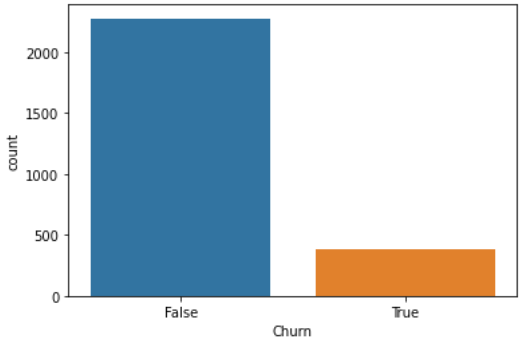

```
#Each Churn count
df['Churn'].value_counts()
```

```
False    2278
True      388
```

```
Name: Churn, dtype: int64
```

```
#Each Churn counts graph
sns.countplot('Churn',data=df)
```

```
/usr/local/lib/python3.9/dist-packages/seaborn/_decorators.py:36: FutureWarning: Pass the following var
  warnings.warn(
<AxesSubplot:xlabel='Churn', ylabel='count'>
```



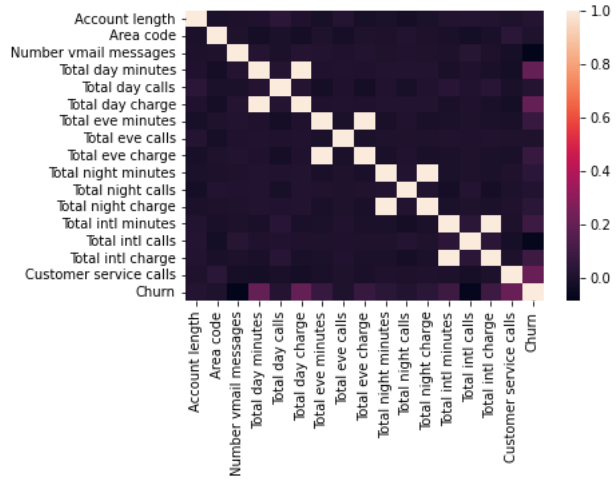
Correlation

```
df.corr()
```

Account Area Number Total Total Total Total Total Total

```
#HeatMap-correlation showing
sns.heatmap(df.corr())
```

```
<AxesSubplot:>
```



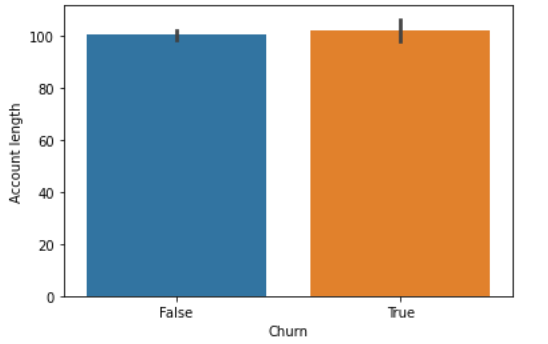
charge

BARPLOT

minutes

```
#Barplot Graph Of  churn & Account length
sns.barplot(x='Churn',y='Account length',data=df)
```

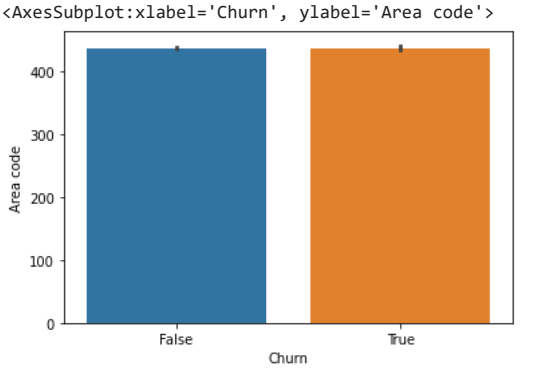
```
<AxesSubplot:xlabel='Churn', ylabel='Account length'>
```



Churn 0.017728 0.001910 0.086474 0.105688 0.018200 0.105680 0.070006 0.001520 0.070802

```
#Barplot Graph Of  churn & area code
sns.barplot(x='Churn',y='Area code',data=df)
```

```
<AxesSubplot:xlabel='Churn', ylabel='Area code'>
```

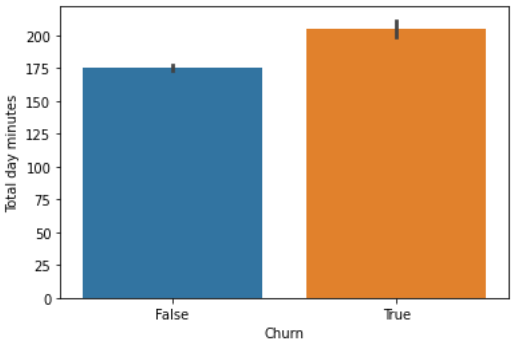



```
#Barplot Graph Of  churn & Number vmail messages
sns.barplot(x='Churn',y='Number vmail messages',data=df)
```

```
<AxesSubplot:xlabel='Churn', ylabel='Number vmail messages'>
```

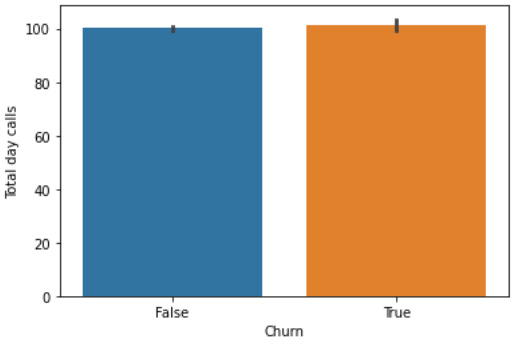
```
#Barplot Graph Of  churn & Total day minutes
sns.barplot(x='Churn',y='Total day minutes',data=df)
```

```
<AxesSubplot:xlabel='Churn', ylabel='Total day minutes'>
```



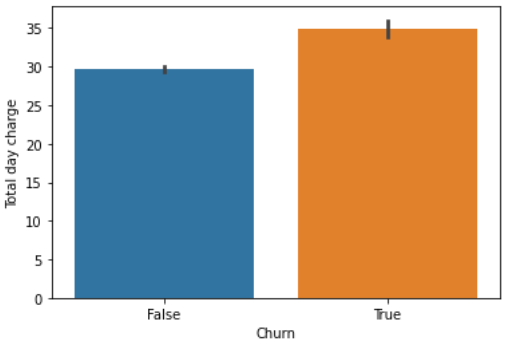

```
#Barplot Graph Of  churn & Total day calls
sns.barplot(x='Churn',y='Total day calls',data=df)
```

```
<AxesSubplot:xlabel='Churn', ylabel='Total day calls'>
```




```
#Barplot Graph Of  churn & Total day charge
sns.barplot(x='Churn',y='Total day charge',data=df)
```

```
<AxesSubplot:xlabel='Churn', ylabel='Total day charge'>
```

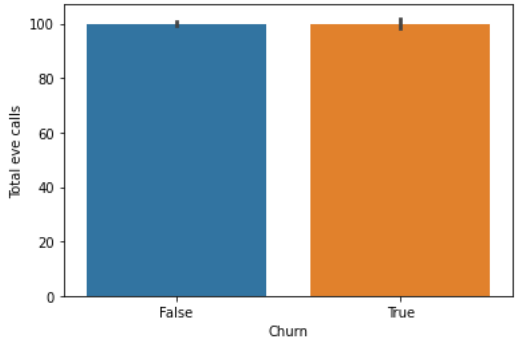



```
#barplot Graph Of Churn & Total eve minutes
sns.barplot(x='Churn',y='Total eve minutes',data=df)
```

```
<AxesSubplot:xlabel='Churn', ylabel='Total eve minutes'>
```

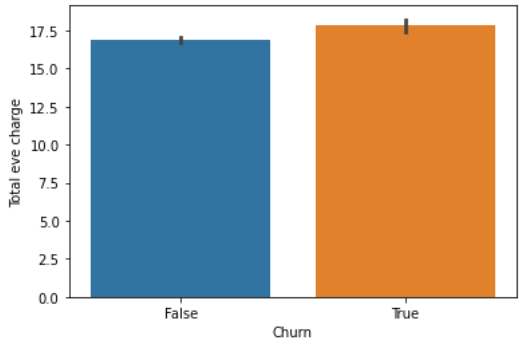
```
#barplot Graph Of Churn & Total eve calls
sns.barplot(x='Churn',y='Total eve calls',data=df)
```

```
<AxesSubplot:xlabel='Churn', ylabel='Total eve calls'>
```



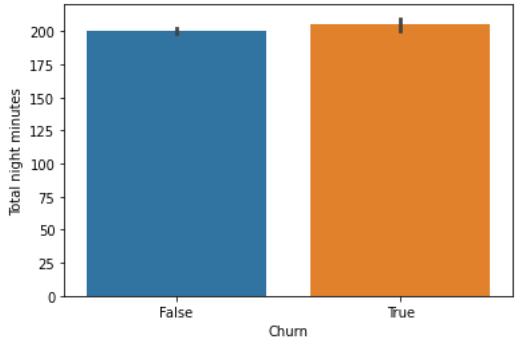

```
#barplot Graph Of Churn & Total eve charge
sns.barplot(x='Churn',y='Total eve charge',data=df)
```

```
<AxesSubplot:xlabel='Churn', ylabel='Total eve charge'>
```



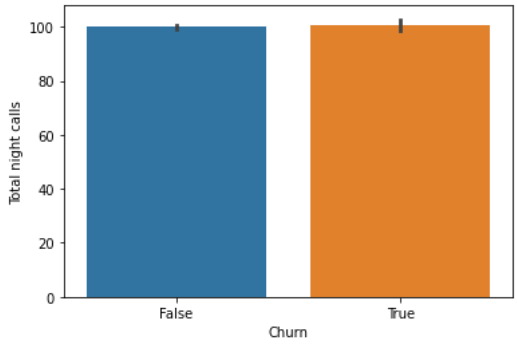

```
#Barplot Graph Of  churn & Total night minutes
sns.barplot(x='Churn',y='Total night minutes',data=df)
```

```
<AxesSubplot:xlabel='Churn', ylabel='Total night minutes'>
```



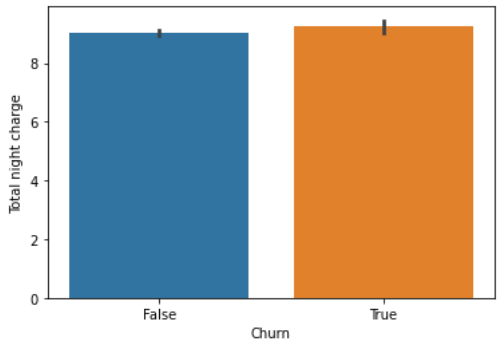

```
#Barplot Graph Of  churn & Total night calls
sns.barplot(x='Churn',y='Total night calls',data=df)
```

```
<AxesSubplot:xlabel='Churn', ylabel='Total night calls'>
```



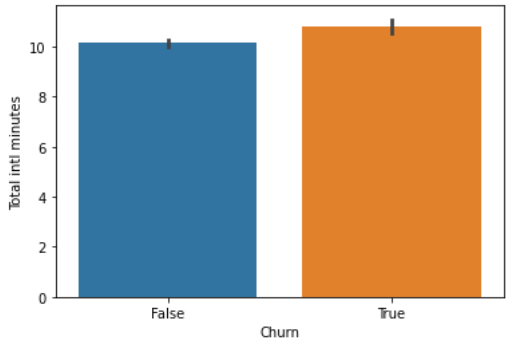

```
#barplot Graph Of Churn & Total night charge
sns.barplot(x='Churn',y='Total night charge',data=df)
```

```
<AxesSubplot:xlabel='Churn', ylabel='Total night charge'>
```



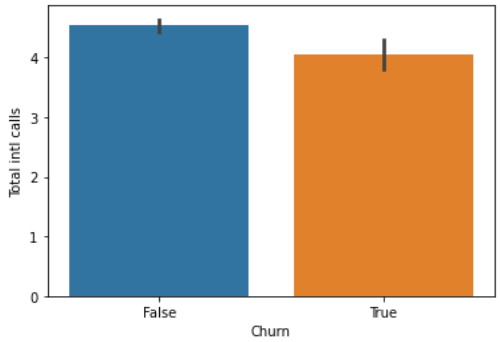

```
#barplot Graph Of  Churn & Total intl minutes
sns.barplot(x='Churn',y='Total intl minutes',data=df)
```

```
<AxesSubplot:xlabel='Churn', ylabel='Total intl minutes'>
```



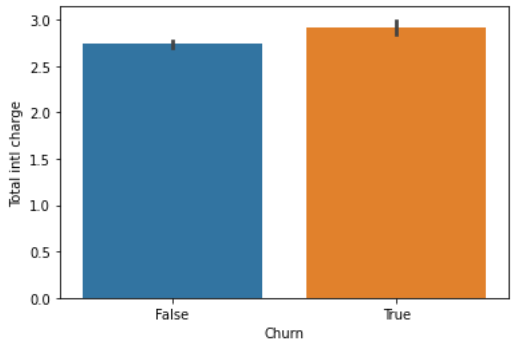

```
#barplot Graph Of churn & Total intl calls
sns.barplot(x='Churn',y='Total intl calls',data=df)
```

```
<AxesSubplot:xlabel='Churn', ylabel='Total intl calls'>
```



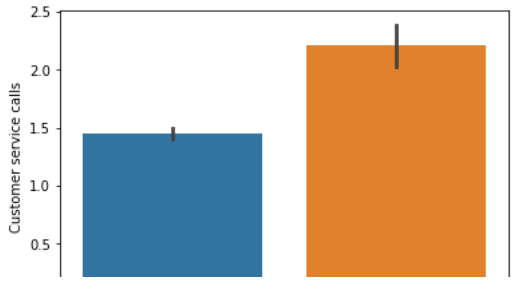

```
#barplot Graph Of churn & Total intl charge
sns.barplot(x='Churn',y='Total intl charge',data=df)
```

```
<AxesSubplot:xlabel='Churn', ylabel='Total intl charge'>
```




```
#barplot Graph Of churn & Customer service calls
sns.barplot(x='Churn',y='Customer service calls',data=df)
```

```
<AxesSubplot:xlabel='Churn', ylabel='Customer service calls'>
```



Encoding string to numeric using getdummies

```
df1=pd.get_dummies(df[['State','International plan','Voice mail plan']],drop_first=True)
df1
```

	State_AL	State_AR	State_AZ	State_CA	State_CO	State_CT	State_DC	State_DE	State_FL	State_G
0	0	0	0	0	0	0	0	0	0	
1	0	0	0	0	0	0	0	0	0	
2	0	0	0	0	0	0	0	0	0	
3	0	0	0	0	0	0	0	0	0	
4	0	0	0	0	0	0	0	0	0	
...	...	...	...	...	...	...	...	...	...	
2661	0	0	0	0	0	0	0	0	0	
2662	0	0	1	0	0	0	0	0	0	
2663	0	0	0	0	0	0	0	0	0	
2664	0	0	0	0	0	0	0	0	0	
2665	0	0	0	0	0	0	0	0	0	

2666 rows × 52 columns

concatination-combining

```
dfe=pd.concat([df,df1],axis=1)
dfe
```

	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	...	State_
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	...	
...	...	...	...	...	...	...	...	...	...	...	...	
2661	SC	79	415	No	No	0	134.7	98	22.90	189.7	...	
2662	AZ	192	415	No	Yes	36	156.2	77	26.55	215.5	...	
2663	WV	68	415	No	No	0	231.1	57	39.29	153.4	...	
2664	RI	28	510	No	No	0	180.8	109	30.74	288.8	...	
2665	TN	74	415	No	Yes	25	234.4	113	39.85	265.9	...	

2666 rows × 72 columns

```
#Dropping unwanted columns
dfe.drop(['State','International plan','Voice mail plan'],axis=1,inplace=True)
dfe
```

	Account length	Area code	Number vmail messages	Total day minutes	Total day calls	Total day charge	Total eve minutes	Total eve calls	Total eve charge	Total night minutes	...	State_TX	S
0	128	415	25	265.1	110	45.07	197.4	99	16.78	244.7	...	0	
1	107	415	26	161.6	123	27.47	195.5	103	16.62	254.4	...	0	
2	137	415	0	243.4	114	41.38	121.2	110	10.30	162.6	...	0	
3	84	408	0	299.4	71	50.90	61.9	88	5.26	196.9	...	0	
4	75	415	0	166.7	113	28.34	148.3	122	12.61	186.9	...	0	
...	...	...	...	...	...	...	...	...	...	...	...	...	
2661	79	415	0	134.7	98	22.90	189.7	68	16.12	221.4	...	0	
2662	192	415	36	156.2	77	26.55	215.5	126	18.32	279.1	...	0	
2663	68	415	0	231.1	57	39.29	153.4	55	13.04	191.3	...	0	
2664	28	510	0	180.8	109	30.74	288.8	58	24.55	191.9	...	0	
2665	74	415	25	234.4	113	39.85	265.9	82	22.60	241.4	...	0	

2666 rows × 69 columns

```
#To find types of columns after encoding,concation,dropping
dfe.dtypes
```

```
Account length              int64
Area code                   int64
Number vmail messages       int64
Total day minutes         float64
Total day calls             int64
                           ...
State_WI                    uint8
State_WV                    uint8
State_WY                    uint8
International plan_Yes      uint8
Voice mail plan_Yes         uint8
Length: 69, dtype: object
```

```
#To find missing values after encoding,concation,dropping
dfe.isna().sum()
```

```
Account length            0
Area code                 0
Number vmail messages     0
Total day minutes         0
Total day calls           0
                         ..
State_WI                  0
State_WV                  0
State_WY                  0
International plan_Yes    0
Voice mail plan_Yes       0
Length: 69, dtype: int64
```

```
#Seperate x_train
x_train=dfe.drop(['Churn'],axis=1)
x_train
```

	Account length	Area code	Number vmail messages	Total day minutes	Total day calls	Total day charge	Total eve minutes	Total eve calls	Total eve charge	Total night minutes	...	State_TX	S
0	128	415	25	265.1	110	45.07	197.4	99	16.78	244.7	...	0	
1	107	415	26	161.6	123	27.47	195.5	103	16.62	254.4	...	0	
2	137	415	0	243.4	114	41.38	121.2	110	10.30	162.6	...	0	
3	84	408	0	299.4	71	50.90	61.9	88	5.26	196.9	...	0	
4	75	415	0	166.7	113	28.34	148.3	122	12.61	186.9	...	0	
...	...	...	...	...	...	...	...	...	...	...	...	...	

```
#Seperate y_train
y_train=dfe['Churn']
y_train
```

```
0       False
1       False
2       False
3       False
4       False
        ...
2661    False
2662    False
2663    False
2664    False
2665    False
Name: Churn, Length: 2666, dtype: bool
```

Preprocessing Testing Data

```
import numpy as np
import pandas as pd
import seaborn as sns
dt=pd.read_csv('/content/churn-bigml-20.csv')
dt
```

	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	Tota ev charg
0	LA	117	408	No	No	0	184.5	97	31.37	351.6	80	29.8
1	IN	65	415	No	No	0	129.1	137	21.95	228.5	83	19.4
2	NY	161	415	No	No	0	332.9	67	56.59	317.8	97	27.0
3	SC	111	415	No	No	0	110.4	103	18.77	137.3	102	11.6
4	HI	49	510	No	No	0	119.3	117	20.28	215.1	109	18.2
...	...	...	...	...	...	...	...	...	...	...	...	
662	WI	114	415	No	Yes	26	137.1	88	23.31	155.7	125	13.2
663	AL	106	408	No	Yes	29	83.6	131	14.21	203.9	131	17.3
664	VT	60	415	No	No	0	193.9	118	32.96	85.0	110	7.2
665	WV	159	415	No	No	0	169.8	114	28.87	197.7	105	16.8
666	CT	184	510	Yes	No	0	213.8	105	36.35	159.6	84	13.5

667 rows × 20 columns

```
#First 5 observation print
dt.head()
```

	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
0	LA	117	408	No	No	0	184.5	97	31.37	351.6	80	29.89
1	IN	65	415	No	No	0	129.1	137	21.95	228.5	83	19.42

```
#Last 5 observation print
dt.tail()
```

	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	Tota ev charg
662	WI	114	415	No	Yes	26	137.1	88	23.31	155.7	125	13.2
663	AL	106	408	No	Yes	29	83.6	131	14.21	203.9	131	17.3
664	VT	60	415	No	No	0	193.9	118	32.96	85.0	110	7.2
665	WV	159	415	No	No	0	169.8	114	28.87	197.7	105	16.8
666	CT	184	510	Yes	No	0	213.8	105	36.35	159.6	84	13.5

```
#Each column types
dt.dtypes
```

```
State                    object
Account length            int64
Area code                 int64
International plan       object
Voice mail plan          object
Number vmail messages     int64
Total day minutes       float64
Total day calls           int64
Total day charge        float64
Total eve minutes       float64
Total eve calls           int64
Total eve charge        float64
Total night minutes     float64
Total night calls         int64
Total night charge      float64
Total intl minutes      float64
Total intl calls          int64
Total intl charge       float64
Customer service calls    int64
Churn                      bool
dtype: object
```

```
#Column heading print
dt.columns
```

```
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')
```

```
#To find missing values
dt.isna().sum()
```

```
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
```

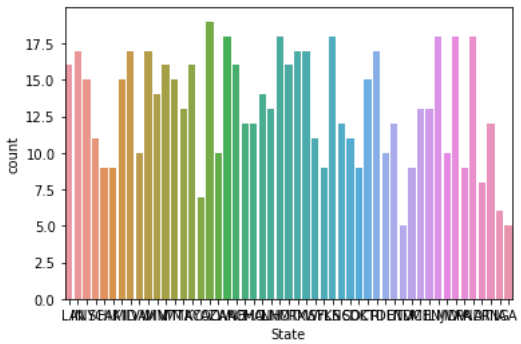
```
Total intl calls          0
Total intl charge         0
Customer service calls    0
Churn                     0
dtype: int64
```

```
#Each state counts
dt['State'].value_counts()
```

```
AZ    19
ND    18
WV    18
NJ    18
KS    18
NM    18
WA    18
RI    17
ID    17
MS    17
WI    17
TX    17
IN    17
LA    16
NE    16
OR    16
KY    16
VT    16
NY    15
MI    15
MT    15
CT    15
AL    14
MN    14
MA    13
IL    13
ME    13
NH    13
TN    12
UT    12
NC    12
MO    12
OH    12
SD    11
WY    11
SC    11
CA    10
DE    10
VA    10
MD    10
FL     9
AK     9
DC     9
HI     9
PA     9
OK     9
AR     8
CO     7
IA     6
NV     5
GA     5
Name: State, dtype: int64
```

```
#Each state counts graph
sns.countplot('State',data=dt)
```

```
/usr/local/lib/python3.9/dist-packages/seaborn/_decorators.py:36: FutureWarning: Pass the following var
  warnings.warn(
<AxesSubplot:xlabel='State', ylabel='count'>
```

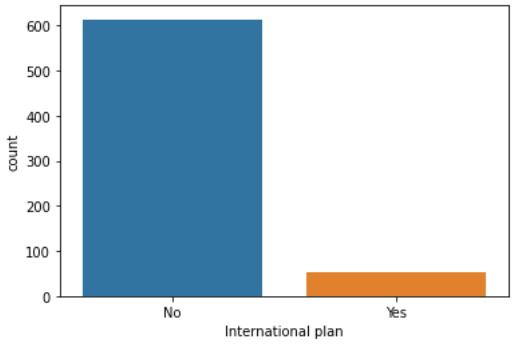


```
#Each International plan counts
dt['International plan'].value_counts()
```

```
No     614
Yes     53
Name: International plan, dtype: int64
```

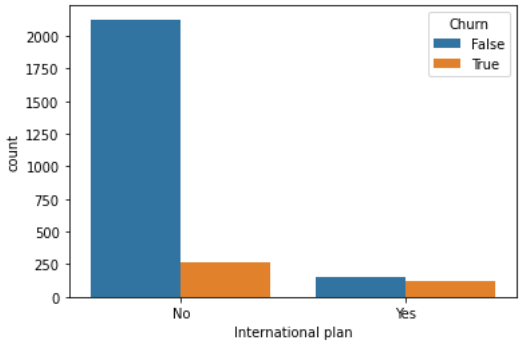
```
#Each International plan counts graph
sns.countplot('International plan',data=dt)
```

```
/usr/local/lib/python3.9/dist-packages/seaborn/_decorators.py:36: FutureWarning: Pass the following var
  warnings.warn(
<AxesSubplot:xlabel='International plan', ylabel='count'>
```




```
#How Each International plan affect Churn graph
sns.countplot('International plan',data=df,hue='Churn')
```

```
/usr/local/lib/python3.9/dist-packages/seaborn/_decorators.py:36: FutureWarning: Pass the following var
  warnings.warn(
<AxesSubplot:xlabel='International plan', ylabel='count'>
```

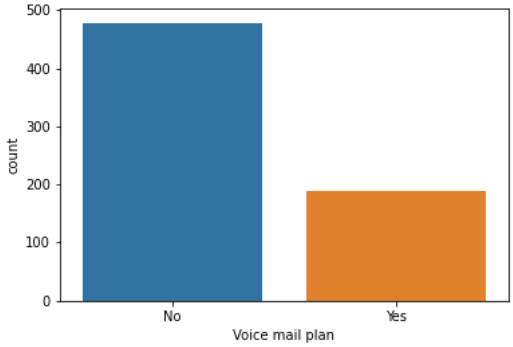



```
#Each Voice mail plan counts
dt['Voice mail plan'].value_counts()
```

```
No     478
Yes    189
Name: Voice mail plan, dtype: int64
```

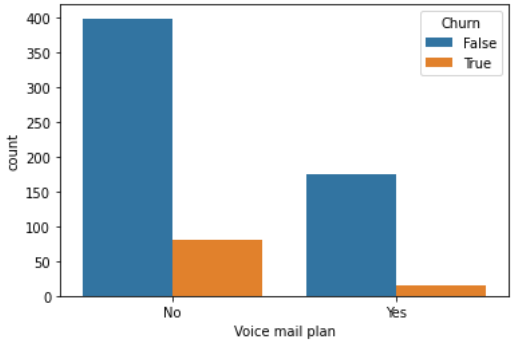
```
#Each Voice mail plan counts graph
sns.countplot('Voice mail plan',data=dt)
```

```
/usr/local/lib/python3.9/dist-packages/seaborn/_decorators.py:36: FutureWarning: Pass the following var
  warnings.warn(
<AxesSubplot:xlabel='Voice mail plan', ylabel='count'>
```



```
#How Each Voice mail plan affect Churn graph
sns.countplot('Voice mail plan',data=dt,hue='Churn')
```

```
/usr/local/lib/python3.9/dist-packages/seaborn/_decorators.py:36: FutureWarning: Pass the following var
  warnings.warn(
<AxesSubplot:xlabel='Voice mail plan', ylabel='count'>
```

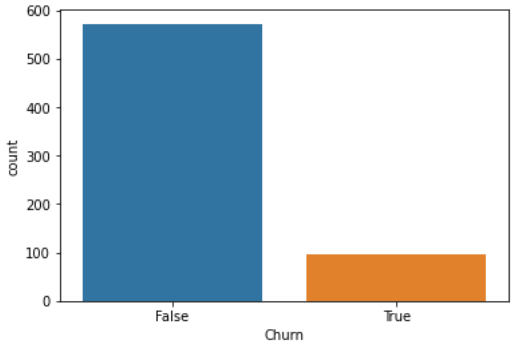



```
#Each churn counts
dt['Churn'].value_counts()
```

```
False    572
True      95
Name: Churn, dtype: int64
```

```
#Each Churn counts graph
sns.countplot('Churn',data=dt)
```

```
/usr/local/lib/python3.9/dist-packages/seaborn/_decorators.py:36: FutureWarning: Pass the following var
  warnings.warn(
<AxesSubplot:xlabel='Churn', ylabel='count'>
```



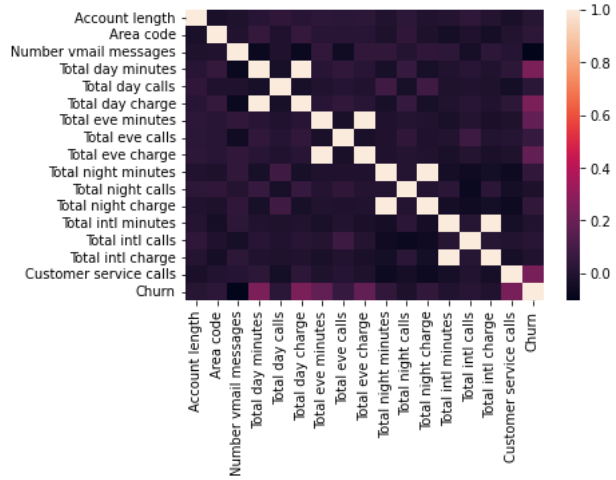
Correlation

```
dt.corr()
```

	Account length	Area code	Number vmail messages	Total day minutes	Total day calls	Total day charge	Total eve minutes	Total eve calls	Total eve charge	
Account length	1.000000	-0.026327	-0.011993	0.017833	0.035703	0.017839	0.027043	0.021237	0.027051	-
Area code	-0.026327	1.000000	-0.006907	0.051507	-0.008972	0.051492	0.017160	0.017783	0.017182	-
Number vmail messages	-0.011993	-0.006907	1.000000	-0.069172	-0.009952	-0.069187	0.040865	-0.051951	0.040876	
Total day minutes	0.017833	0.051507	-0.069172	1.000000	-0.032306	1.000000	0.017987	0.043219	0.017945	-
Total day calls	0.035703	-0.008972	-0.009952	-0.032306	1.000000	-0.032319	-0.004688	0.005851	-0.004664	
Total day charge	0.017839	0.051492	-0.069187	1.000000	-0.032319	1.000000	0.017983	0.043231	0.017941	-
Total eve minutes	0.027043	0.017160	0.040865	0.017987	-0.004688	0.017983	1.000000	-0.029077	1.000000	-
Total eve calls	0.021237	0.017783	-0.051951	0.043219	0.005851	0.043231	-0.029077	1.000000	-0.029089	-
Total eve charge	0.027051	0.017182	0.040876	0.017945	-0.004664	0.017941	1.000000	-0.029089	1.000000	-
Total night minutes	-0.007527	-0.016832	0.039751	-0.031600	0.079536	-0.031613	-0.007705	-0.009856	-0.007691	

```
#Heatmap-correlation showing graph
sns.heatmap(dt.corr())
```

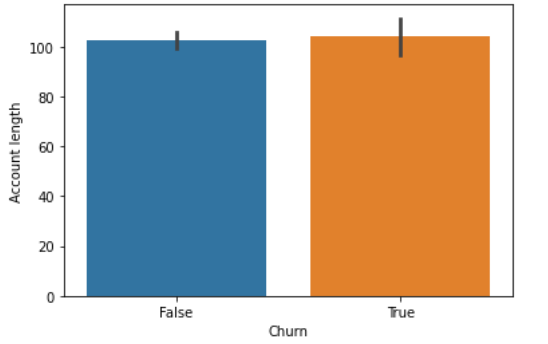
```
<AxesSubplot:>
```



BARPLOT

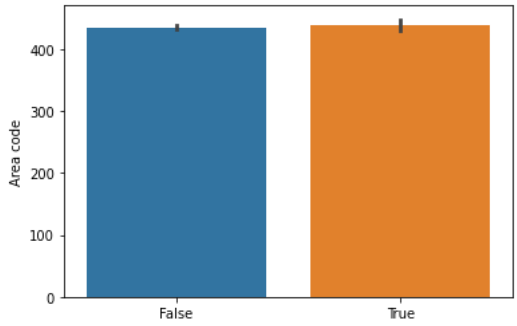
```
#Barplot Graph Of  churn & Account length
sns.barplot(x='Churn',y='Account length',data=dt)
```

```
<AxesSubplot:xlabel='Churn', ylabel='Account length'>
```



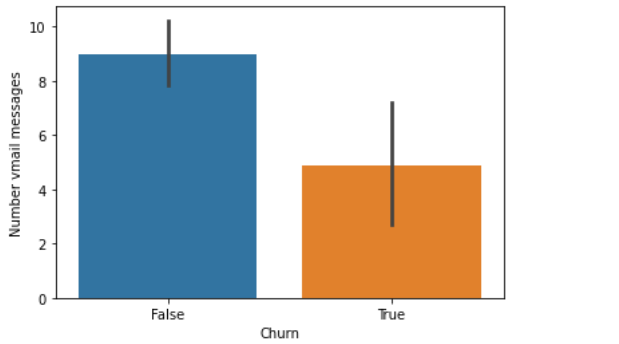

```
#Barplot Graph Of  churn & area code
sns.barplot(x='Churn',y='Area code',data=dt)
```

```
<AxesSubplot:xlabel='Churn', ylabel='Area code'>
```



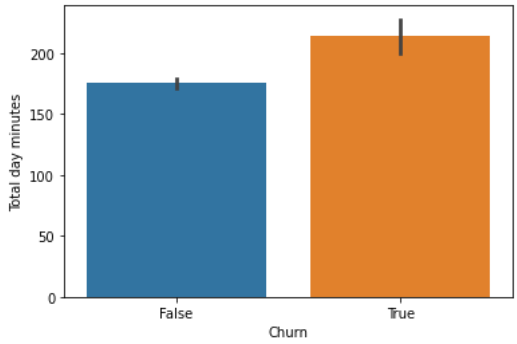

```
#Barplot Graph Of  churn & Number vmail messages
sns.barplot(x='Churn',y='Number vmail messages',data=dt)
```

```
<AxesSubplot:xlabel='Churn', ylabel='Number vmail messages'>
```



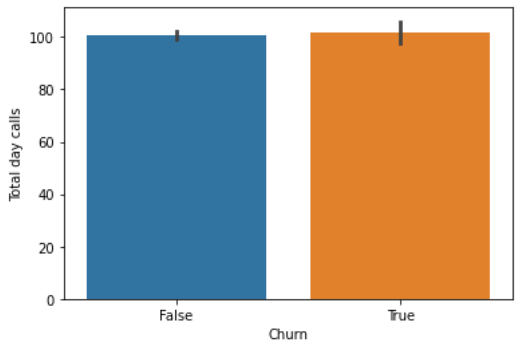

```
#Barplot Graph Of  churn & Total day minutes
sns.barplot(x='Churn',y='Total day minutes',data=dt)
```

```
<AxesSubplot:xlabel='Churn', ylabel='Total day minutes'>
```



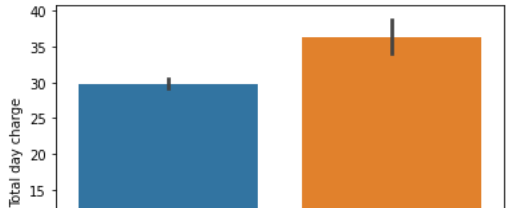

```
#Barplot Graph Of  churn & Total day calls
sns.barplot(x='Churn',y='Total day calls',data=dt)
```

```
<AxesSubplot:xlabel='Churn', ylabel='Total day calls'>
```



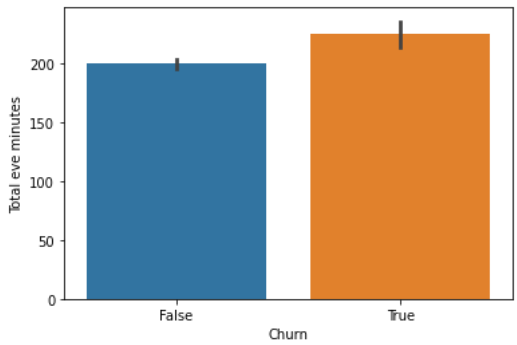

```
#Barplot Graph Of  churn & Total day charge
sns.barplot(x='Churn',y='Total day charge',data=dt)
```

```
<AxesSubplot:xlabel='Churn', ylabel='Total day charge'>
```



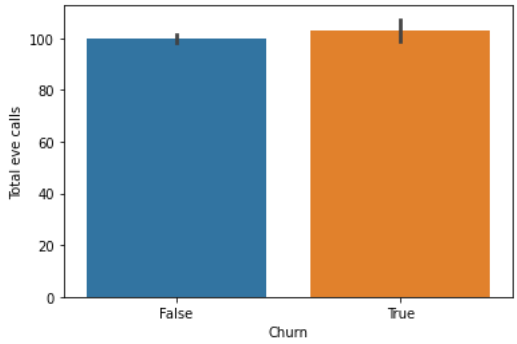

```
#barplot Graph Of Churn & Total eve minutes
sns.barplot(x='Churn',y='Total eve minutes',data=dt)
```

```
<AxesSubplot:xlabel='Churn', ylabel='Total eve minutes'>
```



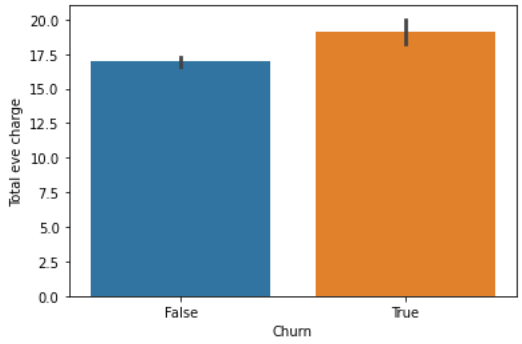

```
#barplot Graph Of Churn & Total eve calls
sns.barplot(x='Churn',y='Total eve calls',data=dte)
```

```
<AxesSubplot:xlabel='Churn', ylabel='Total eve calls'>
```



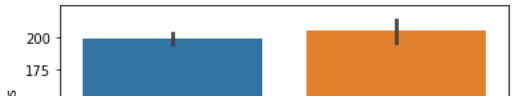

```
#barplot Graph Of Churn & Total eve charge
sns.barplot(x='Churn',y='Total eve charge',data=dt)
```

```
<AxesSubplot:xlabel='Churn', ylabel='Total eve charge'>
```



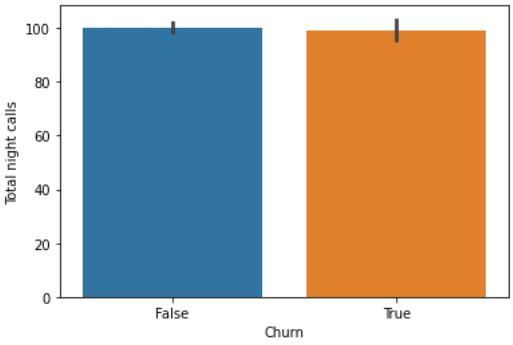

```
#Barplot Graph Of  churn & Total night minutes
sns.barplot(x='Churn',y='Total night minutes',data=dt)
```

```
<AxesSubplot:xlabel='Churn', ylabel='Total night minutes'>
```



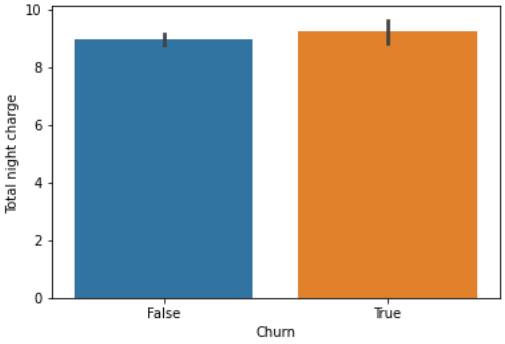

```
#Barplot Graph Of  churn & Total night calls
sns.barplot(x='Churn',y='Total night calls',data=dt)
```

```
<AxesSubplot:xlabel='Churn', ylabel='Total night calls'>
```



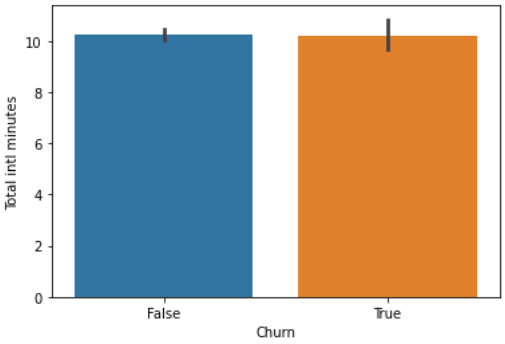

```
#barplot Graph Of Churn & Total night charge
sns.barplot(x='Churn',y='Total night charge',data=dt)
```

```
<AxesSubplot:xlabel='Churn', ylabel='Total night charge'>
```




```
#barplot Graph Of  Churn & Total intl minutes
sns.barplot(x='Churn',y='Total intl minutes',data=dt)
```

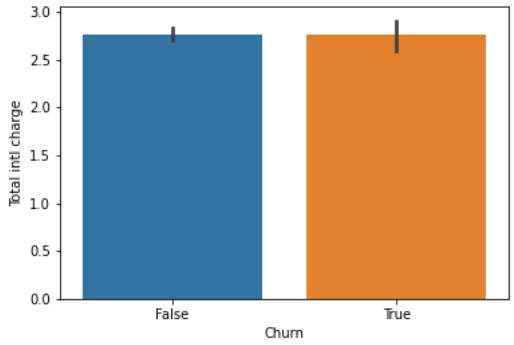
```
<AxesSubplot:xlabel='Churn', ylabel='Total intl minutes'>
```




```
#barplot Graph Of churn & Total intl calls
sns.barplot(x='Churn',y='Total intl calls',data=dt)
```

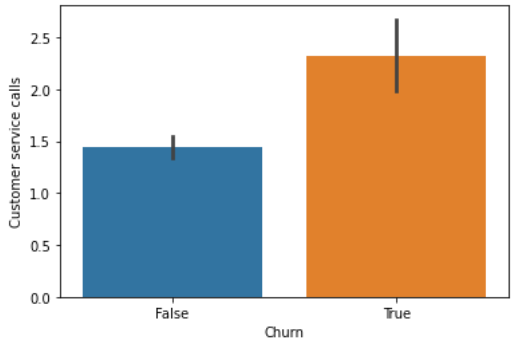
```
#barplot Graph Of churn & Total intl charge
sns.barplot(x='Churn',y='Total intl charge',data=dt)
```

```
<AxesSubplot:xlabel='Churn', ylabel='Total intl charge'>
```




```
#barplot Graph Of churn & Customer service calls
sns.barplot(x='Churn',y='Customer service calls',data=dt)
```

```
<AxesSubplot:xlabel='Churn', ylabel='Customer service calls'>
```



Encoding string to numeric using getdummies

```
dt1=pd.get_dummies(dt[['State','International plan','Voice mail plan']],drop_first=True)
dt1
```

	State_AL	State_AR	State_AZ	State_CA	State_CO	State_CT	State_DC	State_DE	State_FL	State_GA
0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0
...	...	...	...	...	...	...	...	...	...	...
662	0	0	0	0	0	0	0	0	0	0
663	1	0	0	0	0	0	0	0	0	0
664	0	0	0	0	0	0	0	0	0	0
665	0	0	0	0	0	0	0	0	0	0
666	0	0	0	0	0	1	0	0	0	0

667 rows × 52 columns

concatination-combining

```
dte=pd.concat([dt,dt1],axis=1)
dte
```

	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	...	State_T
0	LA	117	408	No	No	0	184.5	97	31.37	351.6	...	
1	IN	65	415	No	No	0	129.1	137	21.95	228.5	...	
2	NY	161	415	No	No	0	332.9	67	56.59	317.8	...	
3	SC	111	415	No	No	0	110.4	103	18.77	137.3	...	
4	HI	49	510	No	No	0	119.3	117	20.28	215.1	...	
...	...	...	...	...	...	...	...	...	...	...	...	
662	WI	114	415	No	Yes	26	137.1	88	23.31	155.7	...	
663	AL	106	408	No	Yes	29	83.6	131	14.21	203.9	...	
664	VT	60	415	No	No	0	193.9	118	32.96	85.0	...	
665	WV	159	415	No	No	0	169.8	114	28.87	197.7	...	
666	CT	184	510	Yes	No	0	213.8	105	36.35	159.6	...	

667 rows × 72 columns

```
#Dropping unwanted columns
dte.drop(['State','International plan','Voice mail plan'],axis=1,inplace=True)
dte
```

	Account length	Area code	Number vmail messages	Total day minutes	Total day calls	Total day charge	Total eve minutes	Total eve calls	Total eve charge	Total night minutes	...	State_TX	St
0	117	408	0	184.5	97	31.37	351.6	80	29.89	215.8	...	0	
1	65	415	0	129.1	137	21.95	228.5	83	19.42	208.8	...	0	
2	161	415	0	332.9	67	56.59	317.8	97	27.01	160.6	...	0	
3	111	415	0	110.4	103	18.77	137.3	102	11.67	189.6	...	0	
4	49	510	0	119.3	117	20.28	215.1	109	18.28	178.7	...	0	
...	...	...	...	...	...	...	...	...	...	...	...	...	
662	114	415	26	137.1	88	23.31	155.7	125	13.23	247.6	...	0	
663	106	408	29	83.6	131	14.21	203.9	131	17.33	229.5	...	0	
664	60	415	0	193.9	118	32.96	85.0	110	7.23	210.1	...	0	
665	159	415	0	169.8	114	28.87	197.7	105	16.80	193.7	...	0	
666	184	510	0	213.8	105	36.35	159.6	84	13.57	139.2	...	0	

667 rows × 69 columns

```
#To find types of columns after encoding,concation,dropping
dte.dtypes
```

```
Account length              int64
Area code                   int64
Number vmail messages       int64
Total day minutes         float64
Total day calls             int64
                           ...
State_WI                    uint8
State_WV                    uint8
State_WY                    uint8
International plan_Yes      uint8
Voice mail plan_Yes         uint8
Length: 69, dtype: object
```

```
#To find missing values after encoding,concation,dropping
dte.isna().sum()
```

```
Account length           0
Area code                0
Number vmail messages    0
Total day minutes        0
```

```
Total day calls           0
                        ..
State_WI                  0
State_WV                  0
State_WY                  0
International plan_Yes    0
Voice mail plan_Yes       0
Length: 69, dtype: int64
```

```
#Seperate x_test
x_test=dte.drop(['Churn'],axis=1)
x_test
```

	Account length	Area code	Number vmail messages	Total day minutes	Total day calls	Total day charge	Total eve minutes	Total eve calls	Total eve charge	Total night minutes	...	State_TX	St
0	117	408	0	184.5	97	31.37	351.6	80	29.89	215.8	...	0	
1	65	415	0	129.1	137	21.95	228.5	83	19.42	208.8	...	0	
2	161	415	0	332.9	67	56.59	317.8	97	27.01	160.6	...	0	
3	111	415	0	110.4	103	18.77	137.3	102	11.67	189.6	...	0	
4	49	510	0	119.3	117	20.28	215.1	109	18.28	178.7	...	0	
...	...	...	...	...	...	...	...	...	...	...	...	...	
662	114	415	26	137.1	88	23.31	155.7	125	13.23	247.6	...	0	
663	106	408	29	83.6	131	14.21	203.9	131	17.33	229.5	...	0	
664	60	415	0	193.9	118	32.96	85.0	110	7.23	210.1	...	0	
665	159	415	0	169.8	114	28.87	197.7	105	16.80	193.7	...	0	
666	184	510	0	213.8	105	36.35	159.6	84	13.57	139.2	...	0	

667 rows × 68 columns

```
#Seperate y_test
y_test=dte['Churn']
y_test
```

```
0      False
1       True
2       True
3      False
4      False
       ...
662    False
663    False
664    False
665    False
666    False
Name: Churn, Length: 667, dtype: bool
```

Normalization using Minmaxscaler

```
from sklearn.preprocessing import MinMaxScaler
scaler=MinMaxScaler()
scaler.fit(x_train)
x_train=scaler.fit_transform(x_train)
x_test=scaler.fit_transform(x_test)
x_train
```

```
array([[0.52479339, 0.06862745, 0.5       , ..., 0.        , 0.        ,
        1.        ],
       [0.43801653, 0.06862745, 0.52      , ..., 0.        , 0.        ,
        1.        ],
       [0.56198347, 0.06862745, 0.        , ..., 0.        , 0.        ,
        0.        ],
       ...,
       [0.2768595 , 0.06862745, 0.        , ..., 0.        , 0.        ,
        0.        ],
       [0.11157025, 1.        , 0.        , ..., 0.        , 0.        ,
        0.        ],
       [0.30165289, 0.06862745, 0.5       , ..., 0.        , 0.        ,
        1.        ]])
```

```
x_test
```

```
array([[0.5021645 , 0.        , 0.        , ..., 0.        , 0.        ,
        0.        ],
       [0.27705628, 0.06862745, 0.        , ..., 0.        , 0.        ,
        0.        ],
       [0.69264069, 0.06862745, 0.        , ..., 0.        , 0.        ,
        0.        ],
       ...,
       [0.25541126, 0.06862745, 0.        , ..., 0.        , 0.        ,
        0.        ],
       [0.68398268, 0.06862745, 0.        , ..., 0.        , 0.        ,
        0.        ],
       [0.79220779, 1.        , 0.        , ..., 0.        , 1.        ,
        0.        ]])
```

Model creation

```
from sklearn.neighbors import KNeighborsClassifier
from sklearn.naive_bayes import MultinomialNB
from sklearn.svm import SVC
K_model=KNeighborsClassifier(n_neighbors=5)
nb_model=MultinomialNB()
sv_model=SVC()
lsb_model=[K_model,nb_model,sv_model]
```

Perfomance Evaluation

Accuracy score,Classification_report

```
from sklearn.metrics import confusion_matrix,accuracy_score,classification_report
for i in lsb_model:
  print(i)
  i.fit(x_train,y_train)
  y_pred=i.predict(x_test)
  result=confusion_matrix(y_test,y_pred)
  print(result)
  print("********************************************")
  print(accuracy_score(y_test,y_pred))
  print("********************************************")
  print(classification_report(y_test,y_pred))
```

```
KNeighborsClassifier()
[[566   6]
 [ 88   7]]
********************************************
0.8590704647676162
********************************************
              precision    recall  f1-score   support

       False       0.87      0.99      0.92       572
        True       0.54      0.07      0.13        95

    accuracy                           0.86       667
   macro avg       0.70      0.53      0.53       667
weighted avg       0.82      0.86      0.81       667

MultinomialNB()
[[569   3]
 [ 91   4]]
********************************************
0.8590704647676162
********************************************
              precision    recall  f1-score   support

       False       0.86      0.99      0.92       572
        True       0.57      0.04      0.08        95

    accuracy                           0.86       667
   macro avg       0.72      0.52      0.50       667
weighted avg       0.82      0.86      0.80       667

SVC()
[[569   3]
 [ 88   7]]
********************************************
0.863568215892054
********************************************
              precision    recall  f1-score   support

       False       0.87      0.99      0.93       572
```

True	0.70	0.07	0.13	95
accuracy			0.86	667
macro avg	0.78	0.53	0.53	667
weighted avg	0.84	0.86	0.81	667

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