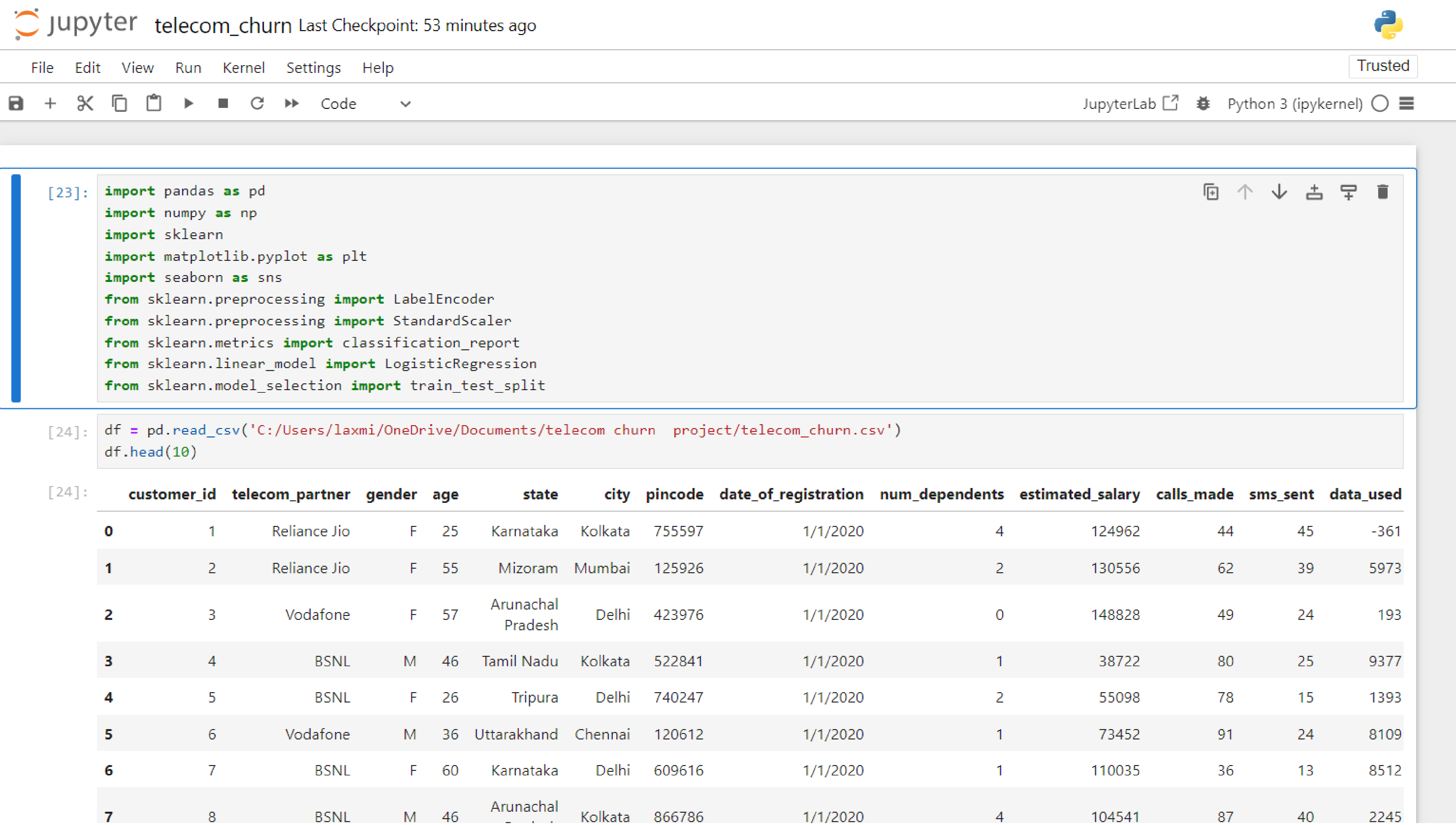


[23]:

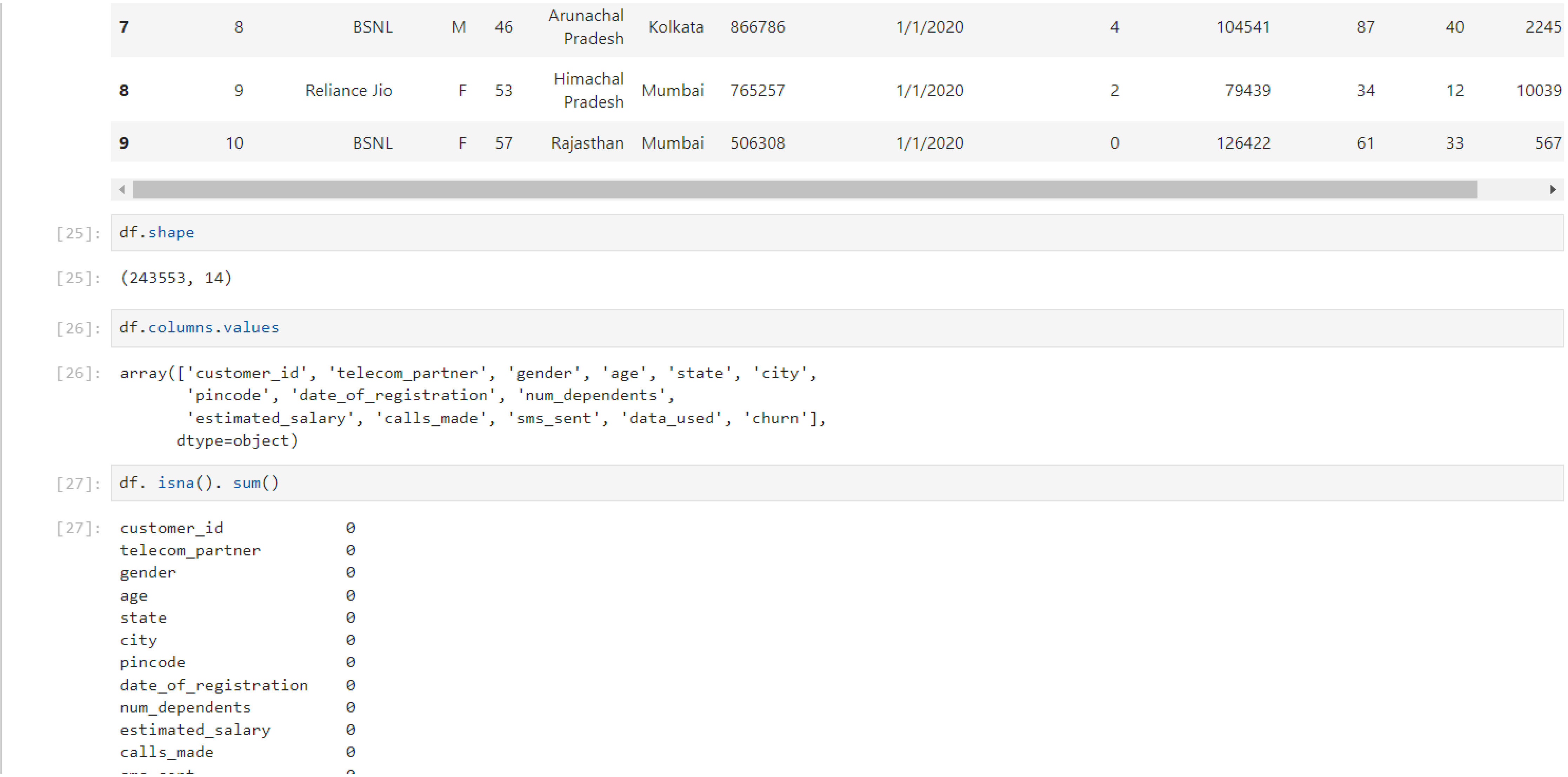
```python
import pandas as pd
import numpy as np
import sklearn
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.preprocessing import LabelEncoder
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import classification_report
from sklearn.linear_model import LogisticRegression
from sklearn.model_selection import train_test_split
```

[24]:

```python
df = pd.read_csv('C:/Users/laxmi/OneDrive/Documents/telecom churn  project/telecom_churn.csv')
df.head(10)
```

[24]:

	customer_id	telecom_partner	gender	age	state	city	pincode	date_of_registration	num_dependents	estimated_salary	calls_made	sms_sent	data_used
0	1	Reliance Jio	F	25	Karnataka	Kolkata	755597	1/1/2020	4	124962	44	45	-361
1	2	Reliance Jio	F	55	Mizoram	Mumbai	125926	1/1/2020	2	130556	62	39	5973
2	3	Vodafone	F	57	Arunachal Pradesh	Delhi	423976	1/1/2020	0	148828	49	24	193
3	4	BSNL	M	46	Tamil Nadu	Kolkata	522841	1/1/2020	1	38722	80	25	9377
4	5	BSNL	F	26	Tripura	Delhi	740247	1/1/2020	2	55098	78	15	1393
5	6	Vodafone	M	36	Uttarakhand	Chennai	120612	1/1/2020	1	73452	91	24	8109
6	7	BSNL	F	60	Karnataka	Delhi	609616	1/1/2020	1	110035	36	13	8512
7	8	BSNL	M	46	Arunachal	Kolkata	866786	1/1/2020	4	104541	87	40	2245



7	8	BSNL	M	46	Arunachal Pradesh	Kolkata	866786	1/1/2020	4	104541	87	40	2245
8	9	Reliance Jio	F	53	Himachal Pradesh	Mumbai	765257	1/1/2020	2	79439	34	12	10039
9	10	BSNL	F	57	Rajasthan	Mumbai	506308	1/1/2020	0	126422	61	33	567

```
[25]: df.shape
```

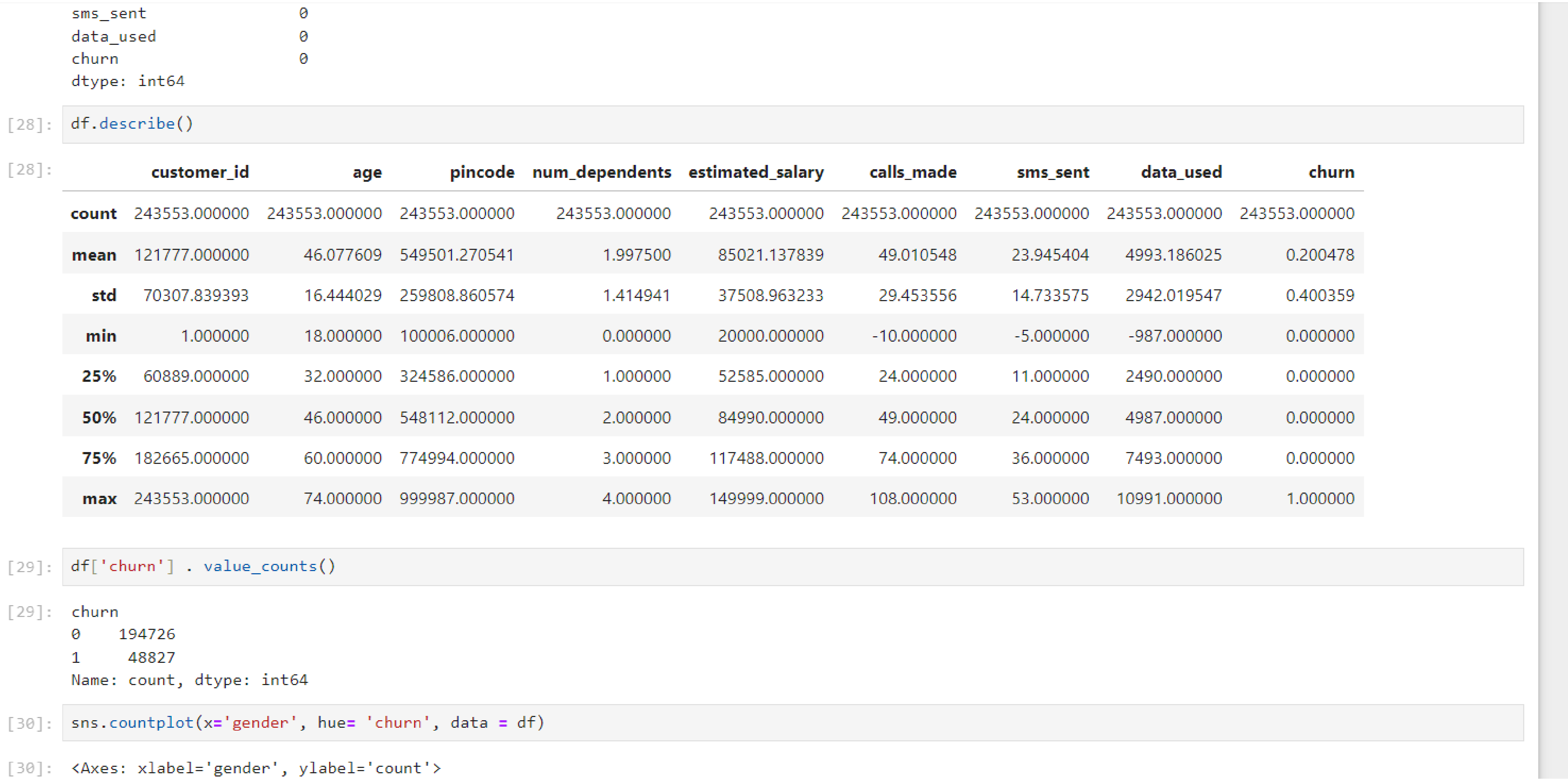
```
[25]: (243553, 14)
```

```
[26]: df.columns.values
```

```
[26]: array(['customer_id', 'telecom_partner', 'gender', 'age', 'state', 'city',
             'pincode', 'date_of_registration', 'num_dependents',
             'estimated_salary', 'calls_made', 'sms_sent', 'data_used', 'churn'],
            dtype=object)
```

```
[27]: df. isna(). sum()
```

```
[27]: customer_id             0
      telecom_partner         0
      gender                  0
      age                     0
      state                   0
      city                    0
      pincode                 0
      date_of_registration    0
      num_dependents          0
      estimated_salary        0
      calls_made              0
      sms_sent                0
```



```
sms_sent               0
data_used              0
churn                  0
dtype: int64
```

[28]:

```
df.describe()
```

[28]:

	customer_id	age	pincode	num_dependents	estimated_salary	calls_made	sms_sent	data_used	churn
count	243553.000000	243553.000000	243553.000000	243553.000000	243553.000000	243553.000000	243553.000000	243553.000000	243553.000000
mean	121777.000000	46.077609	549501.270541	1.997500	85021.137839	49.010548	23.945404	4993.186025	0.200478
std	70307.839393	16.444029	259808.860574	1.414941	37508.963233	29.453556	14.733575	2942.019547	0.400359
min	1.000000	18.000000	100006.000000	0.000000	20000.000000	-10.000000	-5.000000	-987.000000	0.000000
25%	60889.000000	32.000000	324586.000000	1.000000	52585.000000	24.000000	11.000000	2490.000000	0.000000
50%	121777.000000	46.000000	548112.000000	2.000000	84990.000000	49.000000	24.000000	4987.000000	0.000000
75%	182665.000000	60.000000	774994.000000	3.000000	117488.000000	74.000000	36.000000	7493.000000	0.000000
max	243553.000000	74.000000	999987.000000	4.000000	149999.000000	108.000000	53.000000	10991.000000	1.000000

[29]:

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

[29]:

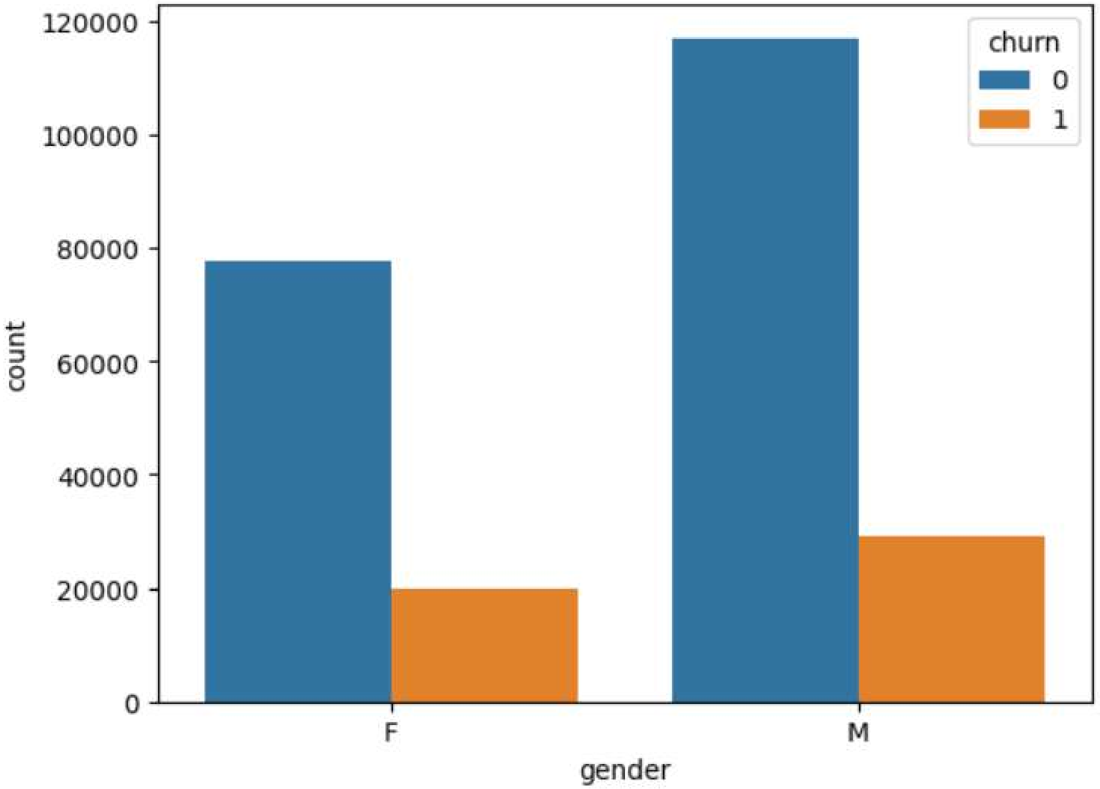
```
churn
0    194726
1     48827
Name: count, dtype: int64
```

[30]:

```
sns.countplot(x='gender', hue= 'churn', data = df)
```

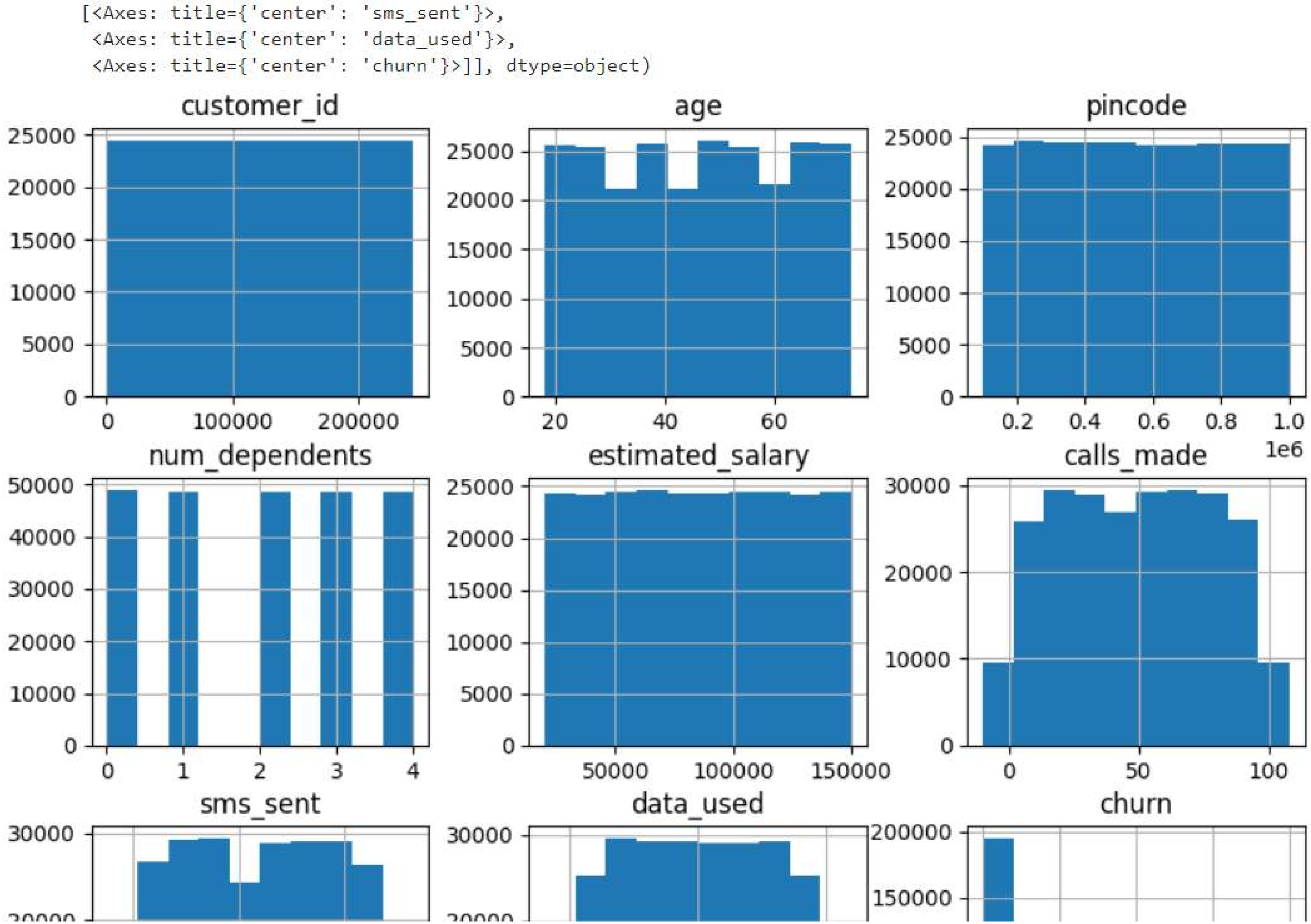
[30]:

```
<Axes: xlabel='gender', ylabel='count'>
```

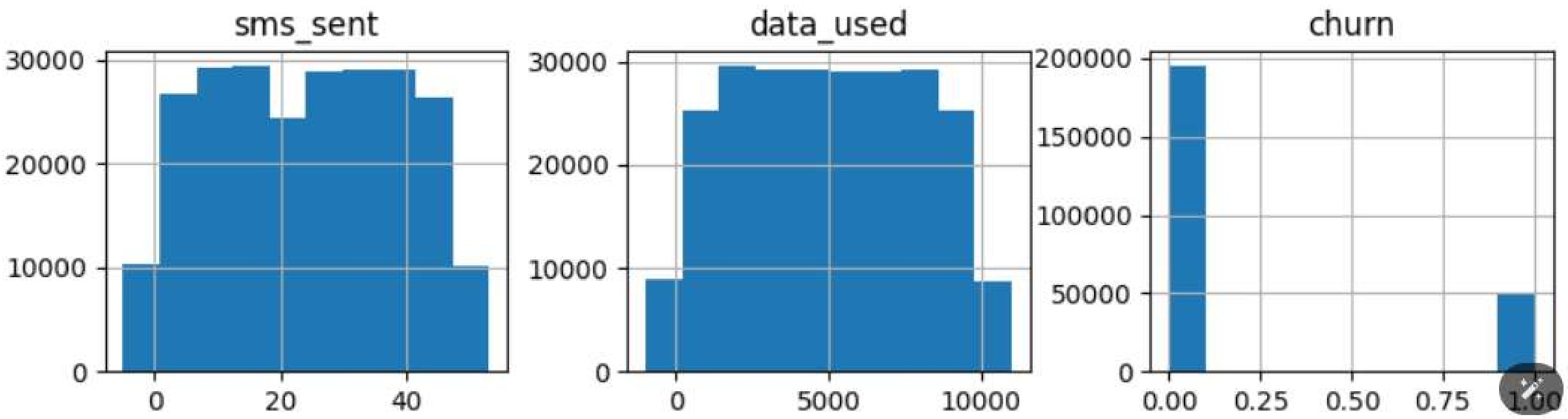


```
[31]: df.hist(figsize=(10, 8))
```

```
[31]: array([[<Axes: title={'center': 'customer_id'}>,
                <Axes: title={'center': 'age'}>,
                <Axes: title={'center': 'pincode'}>],
               [<Axes: title={'center': 'num_dependents'}>,
                <Axes: title={'center': 'estimated_salary'}>,
                <Axes: title={'center': 'calls_made'}>],
```



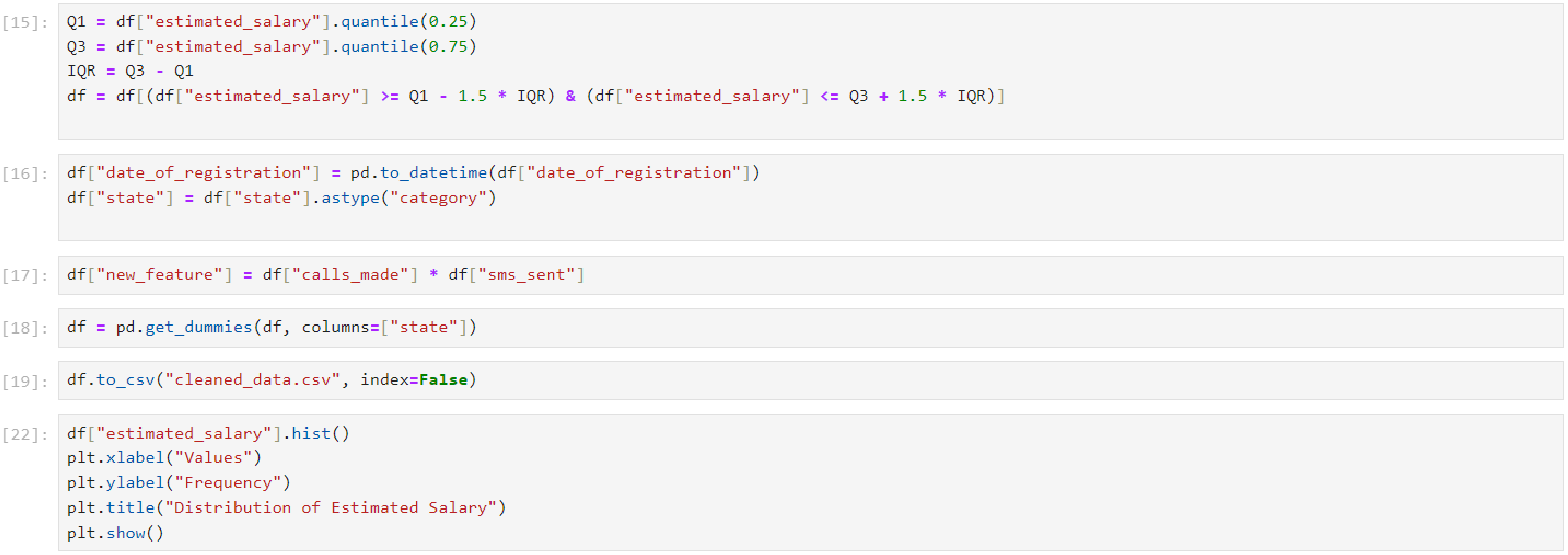
```
[<Axes: title={'center': 'sms_sent'}>,
 <Axes: title={'center': 'data_used'}>,
 <Axes: title={'center': 'churn'}>]], dtype=object)
```



[14]:
```
df.isnull().sum()
```

[14]:
```
customer_id            0
telecom_partner        0
gender                 0
age                    0
state                  0
city                   0
pincode                0
date_of_registration   0
num_dependents         0
estimated_salary       0
calls_made             0
sms_sent               0
data_used              0
churn                  0
dtype: int64
```

[15]:
```
Q1 = df["estimated_salary"].quantile(0.25)
Q3 = df["estimated_salary"].quantile(0.75)
```



[15]:

```
Q1 = df["estimated_salary"].quantile(0.25)
Q3 = df["estimated_salary"].quantile(0.75)
IQR = Q3 - Q1
df = df[(df["estimated_salary"] >= Q1 - 1.5 * IQR) & (df["estimated_salary"] <= Q3 + 1.5 * IQR)]
```

[16]:

```
df["date_of_registration"] = pd.to_datetime(df["date_of_registration"])
df["state"] = df["state"].astype("category")
```

[17]:

```
df["new_feature"] = df["calls_made"] * df["sms_sent"]
```

[18]:

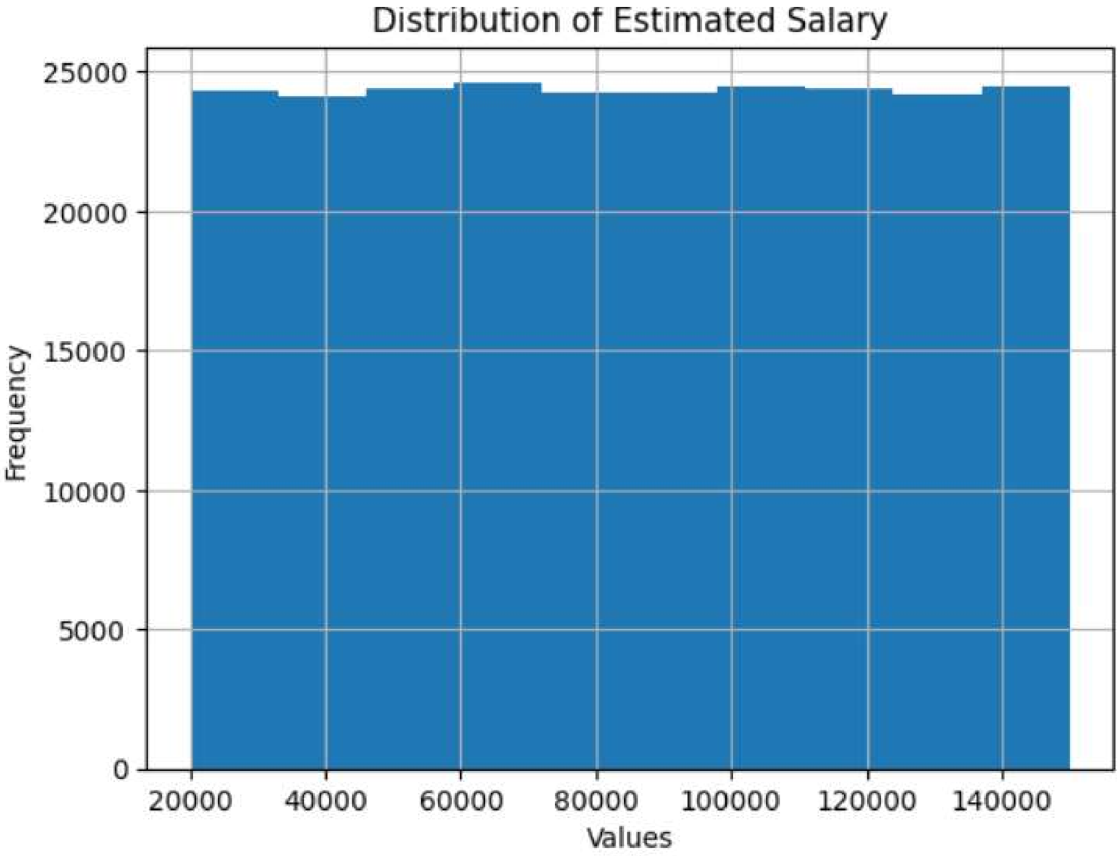
```
df = pd.get_dummies(df, columns=["state"])
```

[19]:

```
df.to_csv("cleaned_data.csv", index=False)
```

[22]:

```
df["estimated_salary"].hist()
plt.xlabel("Values")
plt.ylabel("Frequency")
plt.title("Distribution of Estimated Salary")
plt.show()
```


Distribution of Estimated Salary
Frequency
0
5000
10000
15000
20000
25000
Values
20000
40000
60000
80000
100000
120000
140000