Week 3 Assignment

August 25, 2021

```
[41]: import pandas as pd
       import numpy as np
       import matplotlib.pyplot as plt
       import seaborn as sns
[228]: churn=pd.read_csv('churn.csv')
       churn2=churn.copy()
       churn3=churn.copy()
       churn.head()
[228]:
                                     Contract PaperlessBilling
          customerID tenure
       0 8260-NGFNY
                         One
                              Month-to-month
                                                             No
       1 2359-QWQUL
                          39
                                    One year
                                                            Yes
                           2
       2 6598/RFFVI
                                    One year
                                                             No
       3 IXSTS-8780
                              Month-to-month
                                                            Yes
       4 2674/MIAHT
                              Month-to-month
                                                            Yes
                        Four
                    PaymentMethod
                                    MonthlyCharges
                                                     TotalCharges
                                                                    gender
       0
                      Mailed check
                                               25.2
                                                             25.20
                                                                    Female
                                              104.7
                                                           4134.85
       1
          Credit card (automatic)
                                                                    Female
          Credit card (automatic)
                                               19.3
                                                             28.30
                                                                      Male
       3
                  Electronic check
                                               90.1
                                                            521.30
                                                                    Female
       4
                      Mailed check
                                               80.3
                                                            324.20
                                                                    Female
          SeniorCitizen Partner
                                  ... PhoneService
                                                      MultipleLines InternetService \
                    0.0
       0
                              No
                                               No
                                                   No phone service
                                                                                  DSL
                    0.0
                             Yes
       1
                                              Yes
                                                                          Fiber optic
                    0.0
       2
                                              Yes
                                                                  No
                              No
                                                                                   No
                    0.0
       3
                              No
                                              Yes
                                                                 Yes
                                                                          Fiber optic
                    0.0
                              No
                                              Yes
                                                                 Yes
                                                                         Fiber optic
               OnlineSecurity
                                        OnlineBackup
                                                          DeviceProtection \
                                                  No
       0
                            No
                                                                         No
                                                  No
       1
                           Yes
                                                                        Yes
       2
          No internet service
                                No internet service
                                                      No internet service
       3
                                                 Yes
       4
                            No
                                                 Yes
                                                                         No
```

	TechSupport	${\tt StreamingTV}$	${\tt StreamingMovies}$	Churn
0	No	No	No	Yes
1	Yes	Yes	Yes	Yes
2	No internet service	No internet service	No internet service	Yes
3	No	Yes	No	Yes
4	No	No	No	No

[5 rows x 21 columns]

0.0.1 Solution 2

```
[11]: cust_det_extr1 = churn[churn.InternetService == 'Fiber optic']
      cust_det_extr1.head()
[11]:
         customerID tenure
                                   Contract PaperlessBilling
      1 2359-QWQUL
                         39
                                   One year
                                                          Yes
      3 IXSTS-8780
                          6
                             Month-to-month
                                                          Yes
      4 2674/MIAHT
                       Four
                             Month-to-month
                                                          Yes
      5 6077-BDPXA
                          3
                             Month-to-month
                                                          Yes
      6 7929/SKFGK
                         70
                                   Two year
                                                           No
                                   MonthlyCharges
                                                    TotalCharges
                   PaymentMethod
                                                                   gender
         Credit card (automatic)
                                            104.70
                                                         4134.85
                                                                   Female
      1
      3
                Electronic check
                                             90.10
                                                          521.30
                                                                   Female
                     Mailed check
                                             80.30
                                                          324.20
                                                                   Female
      4
      5
                Electronic check
                                             70.15
                                                          194.20
                                                                   Female
         Credit card (automatic)
                                            114.30
                                                         8244.30
                                                                     Male
         SeniorCitizen Partner
                                 ... PhoneService MultipleLines InternetService \
                   0.0
                            Yes
                                             Yes
                                                                    Fiber optic
      1
                                                            No
                   0.0
      3
                                             Yes
                                                                    Fiber optic
                             No
                                                           Yes
      4
                   0.0
                                             Yes
                                                                    Fiber optic
                             No
                                                           Yes
                   0.0
      5
                             No
                                             Yes
                                                            No
                                                                    Fiber optic
                   0.0
                            Yes ...
                                             Yes
                                                                    Fiber optic
                                                           Yes
        OnlineSecurity OnlineBackup DeviceProtection TechSupport StreamingTV \
      1
                   Yes
                                  No
                                                   Yes
                                                                Yes
                                                                            Yes
      3
                                 Yes
                                                                            Yes
                    No
                                                    No
                                                                 No
      4
                    No
                                 Yes
                                                    No
                                                                 No
                                                                             No
      5
                    No
                                  No
                                                    No
                                                                 No
                                                                             No
                   Yes
                                 Yes
                                                   Yes
                                                                Yes
                                                                            Yes
```

StreamingMovies Churn

1	Yes	Yes
3	No	Yes
4	No	No
5	No	No

```
[5 rows x 21 columns]
[12]: cust_det_extr2 = churn.loc[churn.InternetService == 'Fiber optic']
      cust_det_extr2.head()
[12]:
         customerID tenure
                                   Contract PaperlessBilling \
      1 2359-QWQUL
                         39
                                   One year
                                                          Yes
      3 IXSTS-8780
                                                          Yes
                          6
                            Month-to-month
      4 2674/MIAHT
                      Four
                             Month-to-month
                                                          Yes
      5 6077-BDPXA
                          3
                             Month-to-month
                                                          Yes
      6 7929/SKFGK
                        70
                                   Two year
                                                           No
                   PaymentMethod MonthlyCharges
                                                    TotalCharges
                                                                  gender \
         Credit card (automatic)
                                           104.70
                                                         4134.85
                                                                  Female
      1
                Electronic check
                                             90.10
                                                          521.30
                                                                  Female
      3
      4
                    Mailed check
                                             80.30
                                                          324.20
                                                                  Female
      5
                Electronic check
                                            70.15
                                                          194.20
                                                                  Female
      6 Credit card (automatic)
                                           114.30
                                                         8244.30
                                                                    Male
         SeniorCitizen Partner
                                 ... PhoneService MultipleLines InternetService \
                   0.0
                                            Yes
                            Yes
                                                            No
                                                                   Fiber optic
      1
      3
                   0.0
                             No
                                            Yes
                                                           Yes
                                                                   Fiber optic
                   0.0
                                            Yes
                                                                   Fiber optic
                             No ...
                                                           Yes
      5
                   0.0
                             No
                                            Yes
                                                            No
                                                                   Fiber optic
                   0.0
                            Yes ...
                                            Yes
                                                           Yes
                                                                   Fiber optic
        OnlineSecurity OnlineBackup DeviceProtection TechSupport StreamingTV \
                   Yes
                                  No
                                                   Yes
                                                               Yes
                                                                            Yes
      1
                                 Yes
      3
                    No
                                                    No
                                                                No
                                                                            Yes
      4
                    No
                                 Yes
                                                    No
                                                                No
                                                                             No
      5
                    No
                                  No
                                                    No
                                                                No
                                                                             No
                   Yes
                                 Yes
                                                   Yes
                                                               Yes
                                                                            Yes
        StreamingMovies Churn
      1
                    Yes
                           Yes
                           Yes
      3
                     No
      4
                     No
                            No
      5
                     No
                            No
                    Yes
                            No
      [5 rows x 21 columns]
[13]: cust_det_extr3 = churn.loc[churn.InternetService.isin(['Fiber optic'])]
```

6

Yes

cust_det_extr3.head()

No

```
[13]:
         customerID tenure
                                   Contract PaperlessBilling \
         2359-QWQUL
                        39
                                   One year
                                                         Yes
      3 IXSTS-8780
                         6 Month-to-month
                                                         Yes
      4 2674/MIAHT
                      Four
                            Month-to-month
                                                         Yes
      5 6077-BDPXA
                         3
                            Month-to-month
                                                         Yes
      6 7929/SKFGK
                                   Two year
                                                          No
                        70
                   PaymentMethod MonthlyCharges
                                                   TotalCharges
                                                                  gender \
        Credit card (automatic)
                                           104.70
                                                         4134.85
                                                                  Female
                Electronic check
                                            90.10
      3
                                                         521.30
                                                                  Female
      4
                    Mailed check
                                            80.30
                                                         324.20
                                                                  Female
      5
                Electronic check
                                            70.15
                                                         194.20
                                                                  Female
        Credit card (automatic)
                                           114.30
                                                        8244.30
                                                                    Male
         SeniorCitizen Partner ... PhoneService MultipleLines InternetService \
                   0.0
      1
                           Yes
                                            Yes
                                                           No
                                                                   Fiber optic
      3
                   0.0
                            No ...
                                            Yes
                                                           Yes
                                                                   Fiber optic
                   0.0
      4
                                            Yes
                                                                   Fiber optic
                            No ...
                                                           Yes
      5
                   0.0
                                            Yes
                                                           No
                                                                   Fiber optic
                            No
                   0.0
                           Yes ...
                                            Yes
                                                          Yes
                                                                   Fiber optic
        OnlineSecurity OnlineBackup DeviceProtection TechSupport StreamingTV \
                                 No
                                                  Yes
      1
                   Yes
                                                               Yes
                                                                           Yes
      3
                    No
                                 Yes
                                                   No
                                                                           Yes
                                                                No
      4
                    No
                                 Yes
                                                   No
                                                                No
                                                                            No
      5
                                 No
                                                   No
                                                                            No
                    No
                                                               No
                   Yes
                                 Yes
                                                  Yes
                                                               Yes
                                                                           Yes
        StreamingMovies Churn
      1
                    Yes
                          Yes
      3
                     No
                          Yes
      4
                     No
                           Nο
      5
                     No
                           No
                    Yes
                           Nο
      [5 rows x 21 columns]
[14]: cust_det_extr4 = churn.loc[churn.isin(['Fiber optic'])]
      cust_det_extr4.head()
       ValueError
                                                  Traceback (most recent call last)
       <ipython-input-14-f1ac1091d9a1> in <module>
       ---> 1 cust_det_extr4 = churn.loc[churn.isin(['Fiber optic'])]
             2 cust_det_extr4.head()
```

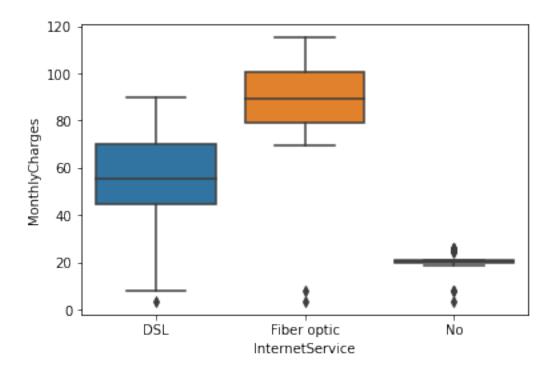
```
C:\ProgramData\Anaconda3\lib\site-packages\pandas\core\indexing.py in_u
        →__getitem__(self, key)
           929
           930
                           maybe_callable = com.apply_if_callable(key, self.obj)
                           return self._getitem_axis(maybe_callable, axis=axis)
       --> 931
           932
           933
                   def is scalar access(self, key: tuple):
      C:\ProgramData\Anaconda3\lib\site-packages\pandas\core\indexing.py in_
       →_getitem_axis(self, key, axis)
          1149
                               if hasattr(key, "ndim") and key.ndim > 1:
          1150
                                   raise ValueError("Cannot index with multidimensional
       -> 1151
       →key")
          1152
          1153
                               return self._getitem_iterable(key, axis=axis)
      ValueError: Cannot index with multidimensional key
     0.0.2 Solution 3
[18]: [i for i in churn['customerID'] if len(i)!=10]
[18]: []
     Answer: All the customer IDs are consistent
     0.0.3 Solution 4
[27]: churn2['Dependents'].value_counts()
[27]: No
             171
      Yes
              80
      1@#
               6
      Name: Dependents, dtype: int64
[39]: churn2['Dependents'].replace('10#','No',inplace=True)
[40]: churn2['Dependents'].value_counts()
[40]: No
             177
      Yes
              80
      Name: Dependents, dtype: int64
```

Answer: 177, 80

0.0.4 Solution 5

```
[42]: sns.boxplot(y='MonthlyCharges',x='InternetService',data=churn)
```

[42]: <AxesSubplot:xlabel='InternetService', ylabel='MonthlyCharges'>



Answer: Customers who have opted for a Fiber optic line pay more than for a DSL connection

0.0.5 Solution 6

A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy return super().drop(

[98]: churn_nointernet.replace('No internet service',np.nan,inplace=True) churn_nointernet.head()

 $\label{limits} $$C:\Pr{packages\pi} \align{ \begin{tikzpicture} \label{limits} Core \align{ \begin{tikzpicture} \label{limits} \label{limits} \label{limits} \label{limits} \label{limits} \align{ \begin{tikzpicture} \label{limits} \label{limits} \label{limits} \label{limits} \align{ \begin{tikzpicture} \label{limits} \label{limits} \label{limits} \label{limits} \label{limits} \label{limits} \label{limits} \align{ \begin{tikzpicture} \label{limits} \label{limits} \label{limits} \label{limits} \label{limits} \align{ \begin{tikzpicture} \label{limits} \label{limits} \label{limits} \label{limits} \label{limits} \align{ \begin{tikzpicture} \label{limits} \label{limits} \label{limits} \label{limits} \label{limits} \label{limits} \label{limits} \align{ \begin{tikzpicture} \label{limits} \label{li$

A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy return super().replace(

[98]:	OnlineSecurity	OnlineBackup	${ t DeviceProtection}$	TechSupport	${ t Streaming TV}$	'
2	NaN	NaN	NaN	NaN	NaN	
8	NaN	NaN	NaN	NaN	NaN	
13	Yes	Yes	NaN	NaN	Yes	
14	NaN	NaN	NaN	NaN	NaN	
15	Yes	Yes	NaN	NaN	Yes	
	StreamingMovie	es				
2	Na	aN				
8	Na	aN				
4.0	3.7	3.7				

8 NaN
13 NaN
14 NaN
15 NaN

[97]: len(churn_nointernet.any(1)[churn_nointernet.any(1)==True])

[97]: 25

Answer: 25

0.0.6 Solution 7

[229]: churn3.info()

<class 'pandas.core.frame.DataFrame'>
RangeIndex: 257 entries, 0 to 256
Data columns (total 21 columns):

#	Column	Non-Null Count	Dtype
0	customerID	257 non-null	object
1	tenure	257 non-null	object
2	Contract	257 non-null	object
3	PaperlessBilling	257 non-null	object
4	PaymentMethod	257 non-null	object
5	${ t Monthly Charges}$	247 non-null	float64
6	TotalCharges	242 non-null	float64
7	gender	257 non-null	object
8	SeniorCitizen	252 non-null	float64
9	Partner	257 non-null	object
10	Dependents	257 non-null	object
11	PhoneService	257 non-null	object

```
12 MultipleLines
                        257 non-null
                                         object
 13
    InternetService
                        257 non-null
                                         object
 14
     OnlineSecurity
                        257 non-null
                                         object
                        257 non-null
 15
     OnlineBackup
                                         object
 16 DeviceProtection 257 non-null
                                         object
     TechSupport
 17
                        257 non-null
                                         object
     StreamingTV
                        257 non-null
                                         object
 19
     StreamingMovies
                        257 non-null
                                         object
 20 Churn
                        257 non-null
                                         object
dtypes: float64(3), object(18)
memory usage: 42.3+ KB
churn3.head()
   customerID tenure
                              Contract PaperlessBilling \
0 8260-NGFNY
                  One
                       Month-to-month
                                                      No
1
   2359-QWQUL
                   39
                              One year
                                                     Yes
2 6598/RFFVI
                    2
                              One year
                                                      No
3 IXSTS-8780
                    6
                       Month-to-month
                                                     Yes
4 2674/MIAHT
                 Four Month-to-month
                                                     Yes
              PaymentMethod MonthlyCharges
                                                             gender
                                              TotalCharges
               Mailed check
                                        25.2
                                                      25.20
                                                             Female
0
   Credit card (automatic)
                                       104.7
                                                    4134.85
                                                             Female
2
   Credit card (automatic)
                                        19.3
                                                      28.30
                                                               Male
3
           Electronic check
                                        90.1
                                                     521.30
                                                             Female
4
               Mailed check
                                        80.3
                                                     324.20 Female
   SeniorCitizen Partner
                          ... PhoneService
                                               MultipleLines InternetService
0
              0.0
                       No
                                        No
                                            No phone service
                                                                           DSL
              0.0
                                                                   Fiber optic
1
                      Yes
                                       Yes
2
              0.0
                       No
                                       Yes
                                                           No
3
              0.0
                                                                  Fiber optic
                       No
                                       Yes
                                                          Yes
              0.0
                       No
                                       Yes
                                                          Yes
                                                                  Fiber optic
                                                   DeviceProtection
        OnlineSecurity
                                 OnlineBackup
0
                     No
                                           No
                                                                 No
1
                    Yes
                                           No
                                                                Yes
2
   No internet service
                         No internet service
                                               No internet service
3
                                          Yes
                                                                 No
                     No
4
                     No
                                          Yes
                                                                 No
            TechSupport
                                  StreamingTV
                                                    StreamingMovies Churn
0
                     No
                                           No
                                                                 No
                                                                       Yes
                                                                       Yes
1
                    Yes
                                          Yes
                                                                Yes
   No internet service
                         No internet service
                                                                       Yes
                                               No internet service
```

[230]:

[230]:

3

No

Yes

Yes

4 No No No No No

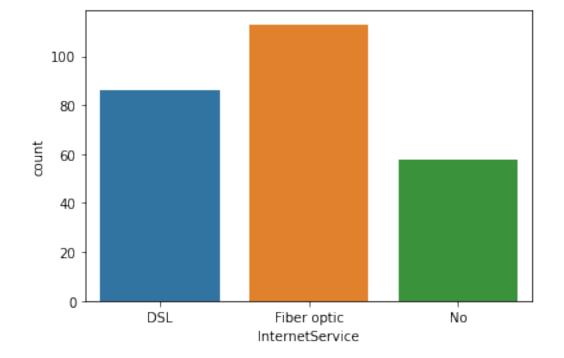
[5 rows x 21 columns]

```
[231]: sns.countplot(churn3['InternetService'])
```

C:\ProgramData\Anaconda3\lib\site-packages\seaborn_decorators.py:36:
FutureWarning: Pass the following variable as a keyword arg: x. From version 0.12, the only valid positional argument will be `data`, and passing other arguments without an explicit keyword will result in an error or misinterpretation.

warnings.warn(

[231]: <AxesSubplot:xlabel='InternetService', ylabel='count'>



```
for k in range (14,20):
    churn3.iloc[j,k]='No internet service'
```

<ipython-input-238-5806b7a53505>:9: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy churn3['InternetService'][j]=churn3['InternetService'].mode()[0]

[241]: churn3.head(50)

[241]:		customerID	tenure	Contract	PaperlessBilling	\
	0	8260-NGFNY	One	Month-to-month	No	•
	1	2359-QWQUL	39	One year	Yes	
	2	6598/RFFVI		One year	No	
	3	IXSTS-8780		Month-to-month	Yes	
	4	2674/MIAHT	Four	Month-to-month	Yes	
	5	6077-BDPXA	3	Month-to-month	Yes	
	6	7929/SKFGK	70	Two year	No	
	7	7547-EKNFS	42	Month-to-month	Yes	
	8	5854-KSRBJ	70	Two year	No	
	9	5054-IEXZT	One	Month-to-month	Yes	
	10	1877-HKBQX	11	One year	Yes	
	11	7235-NXZCP	2	Month-to-month	Yes	
	12	3325-FUYCG	28	One year	No	
	13	2452-MRMZF	72	Two year	Yes	
	14	9184-GALIL	38	Month-to-month	No	
	15	9374-Y0LBJ	One	Month-to-month	No	
	16	2612-PHGOX	64	Two year	Yes	
	17	6874-SGLHU	30	One year	Yes	
	18	9588-YRFHY	49	Two year	Yes	
	19	6513-EECDB	One	Month-to-month	Yes	
	20	1306-RPWXZ	49	Two year	No	
	21	3797-VTIDR	One	Month-to-month	Yes	
	22	2657-VPXTA	10	Month-to-month	Yes	
	23	8464-EETCQ	57	Two year	No	
	24	0307-BCOPK	16	One year	No	
	25	9762-YAQAA	39	One year	No	
	26	1114-CENIM	54	Month-to-month	Yes	
	27	1090-PYKCI	69	One year	Yes	
	28	6362-QHAFM	42	One year	Yes	
	29	7978-DKUQH	25	Month-to-month	Yes	
	30	6463-HHXJR	71	Two year	No	
	31	2592-YKDIF	One	Month-to-month	No	
	32	3307-TLCUD	17	Month-to-month	No	
	33	6651-AZVTJ	49	Month-to-month	Yes	

34	7181-0QCUT	21	Month-to-month	1	No		
35	2307-FYNNL	65	Two year		Yes		
36	3671-SHRSP	Four	Month-to-month		Yes		
37	3399-BMLVW	51	Two year	<u>.</u>	No		
38	7572-KPVKK	62	Two year		Yes		
39	8898-KASCD	39	One year		No		
40	8853-TZDGH	72	Two year		Yes		
41	4910-AQFFX	9	Month-to-month		Yes		
42	7359-SSBJK	64	Two year	:	Yes		
43	4106-HADHQ	39	One year		No		
44	4822-NGOCH	13	Month-to-month	1	Yes		
45	9067-SQTNS	44	One year	:	No		
46	9067-SQTNS	44	One year	:	No		
47	9067-SQTNS	44	One year	:	No		
48	9067-SQTNS	44	One year	•	No		
49	9067-SQTNS	44	One year	:	No		
		Pavmen	tMethod Month	LyCharges	TotalCharges	gender	\
0		•	d check	25.20	25.20	_	
1	Credit car	d (aut	omatic)	104.70	4134.85	Female	
2	Credit car	d (aut	omatic)	19.30	28.30	Male	
3	El€	ectroni	c check	90.10	521.30	Female	
4		Maile	d check	80.30	324.20	Female	
5	El€	ectroni	c check	70.15	194.20	Female	
6	Credit car	rd (aut	omatic)	114.30	8244.30	Male	
7	Bank transfe	er (aut	omatic)	95.25	3959.35	Male	
8		Maile	d check	25.40	1782.05	Male	
9	El€	ectroni	c check	75.35	75.35	Male	
10		Maile	d check	54.60	617.85	Female	
11			d check	74.85	156.40	Male	
12			c check	106.10	2847.40	Male	
13	Credit car			25.70	NaN	Female	
14			d check	20.45	781.25	Female	
15			c check	19.25	19.25	Female	
16	Bank transfe			76.10	4818.80	Male	
17	Bank transfe			97.00	3021.30	Male	
18	Credit car			19.90	1022.60	Male	
19			c check	73.55	73.55	Male	
20	Credit car			8.00	1024.65	Female	
21			c check	23.45	23.45	Male	
22			c check	3.50	929.45	Female	
23 24	Credit car		omatic) d check	18.80	1094.35	Male Female	
24 25	Credit car			19.05 81.40	326.65 3213.75	Male	
25 26	Credit car			55.00	3092.65	Male	
26 27	Credit car			105.10	7234.80	Female	
28			c check	103.10	4586.15	Male	
20	ĽΙŧ	O OI OIII	CHECK	100.30	±000.10	nare	

2 0.0 No Yes No 3 0.0 No Yes Yes Fibe 4 0.0 No Yes Yes Fibe 5 0.0 No Yes No Fibe 6 0.0 Yes Yes Yes Fibe 7 0.0 Yes Yes Yes Fibe 8 0.0 Yes Yes No Fibe 9 0.0 No Yes No Fibe 10 0.0 No Yes Yes Fibe 11 1.0 No Yes Yes Fibe 12 0.0 Yes Yes Yes Fibe 13 1.0 Yes Yes No Fibe 14 0.0 Yes Yes No Fibe 15 0.0 Yes Yes </th <th></th>										
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45		0	.0 Ye	s	•	Yes					No	Fiber	optic
46		0	.0 Ye	s	•	Yes					No	Fiber	optic
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18	No	${\tt internet}$	service	No	${\tt internet}$	servi	се	No	int	ernet	servi	ce	

19	No	${\tt internet}$	service	No	${\tt internet}$	service	No	${\tt internet}$	service	
20	No	${\tt internet}$	service	No	${\tt internet}$	service	No	${\tt internet}$	service	
21	No	${\tt internet}$	service	No	${\tt internet}$	service	No	${\tt internet}$	service	
22			No			No			No	
23			Yes			Yes	No	${\tt internet}$	service	
24	No	internet	service	No	internet	service	No	internet	service	
25	No	internet	service	No	internet	service	No	internet	service	
26	No	internet	service	No	internet	service	No	internet	service	
27			Yes			Yes			Yes	
28			No			No			Yes	
29	No	internet	service	No	internet	service	No	internet	service	
30			Yes			Yes			Yes	
31	No	internet	service	No	internet	service	No	internet	service	
32			Yes			No			Yes	
33			No			No			Yes	
34			Yes			No			Yes	
35			Yes			No			Yes	
36			No			No			Yes	
37			Yes			Yes			No	
38			No			No			Yes	
39			No			No			Yes	
40			No			Yes			Yes	
41	No	internet	service	No	internet	service	No	internet	service	
42			Yes			Yes			No	
43			Yes			No			Yes	
44			No			Yes			Yes	
45			Yes			Yes	No	internet	service	
46			Yes			Yes	No	internet	service	
47			Yes			Yes	No	internet	service	
48			Yes			Yes	No	internet	service	
49			Yes			Yes	No	internet	service	
		Tecl	Support		Str	eamingTV		Streamin	ngMovies	Churn
0	No	${\tt internet}$	service	No	${\tt internet}$	service	No	${\tt internet}$	service	Yes
1			Yes			Yes			Yes	Yes
2	No	${\tt internet}$	service	No	${\tt internet}$	service	No	${\tt internet}$	service	Yes
3			No			Yes			No	Yes
4	No	${\tt internet}$	service	No	${\tt internet}$	service	No	${\tt internet}$	service	No
5	No	${\tt internet}$	service	No	${\tt internet}$	service	No	${\tt internet}$	service	No
6			Yes			Yes			Yes	No
7			No			Yes			No	Yes
8	No	${\tt internet}$	service	No	internet	service	No	${\tt internet}$	service	No
9	No	${\tt internet}$	service	No	internet	service	No	${\tt internet}$	service	Yes
10			Yes			No			No	No
11	No	internet	service	No	internet	service	No	internet	service	Yes
12			No			Yes			Yes	Yes
13	No	${\tt internet}$	service			Yes	No	${\tt internet}$	service	No

14	No	internet	service	No	internet	service	No	internet	service	No
15	No	internet	service			Yes	No	internet	service	No
16			Yes	No	internet	service	No	internet	service	No
17			No			Yes			Yes	No
18	No	internet	service	No	internet	service	No	internet	service	No
19	No	internet	service	No	internet	service	No	internet	service	Yes
20	No	internet	service	No	internet	service	No	internet	service	No
21	No	internet	service	No	internet	service	No	internet	service	Yes
22			No			Yes			Yes	No
23	No	internet	service			Yes	No	internet	service	No
24	No	${\tt internet}$	service	No	${\tt internet}$	service	No	${\tt internet}$	service	No
25	No	${\tt internet}$	service	No	${\tt internet}$	service	No	${\tt internet}$	service	No
26	No	${\tt internet}$	service	No	${\tt internet}$	service	No	${\tt internet}$	service	Yes
27			Yes			Yes			No	No
28			Yes			Yes			Yes	No
29	No	${\tt internet}$	service	No	${\tt internet}$	service	No	${\tt internet}$	service	No
30			No			Yes			No	No
31	No	${\tt internet}$	service	No	${\tt internet}$	service	No	${\tt internet}$	service	No
32			No			No			No	No
33			No			Yes			Yes	Yes
34			No			Yes			Yes	No
35			Yes			Yes			Yes	No
36			Yes			No			No	Yes
37			Yes			No			No	No
38			Yes			Yes			Yes	No
39			Yes			No			No	No
40			Yes			Yes			Yes	No
41	No	internet	service	No	internet	service	No	internet	service	Yes
42			Yes	No	internet	service	No	internet	service	Yes
43			Yes			Yes			Yes	Yes
44			No			No			No	Yes
45	No	internet	service			Yes	No	internet	service	No
46	No	internet	service			Yes	No	internet	service	No
47	No	internet	service			Yes	No	internet	service	No
48	No	internet	service			Yes	No	internet	service	No
49	No	internet	service			Yes	No	internet	service	No

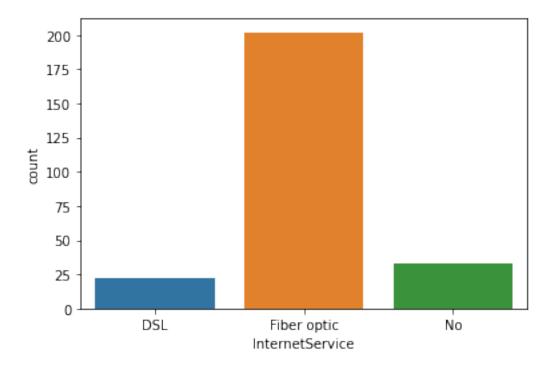
[50 rows x 21 columns]

[240]: sns.countplot(churn3['InternetService'])

C:\ProgramData\Anaconda3\lib\site-packages\seaborn_decorators.py:36:
FutureWarning: Pass the following variable as a keyword arg: x. From version 0.12, the only valid positional argument will be `data`, and passing other arguments without an explicit keyword will result in an error or misinterpretation.

warnings.warn(

[240]: <AxesSubplot:xlabel='InternetService', ylabel='count'>

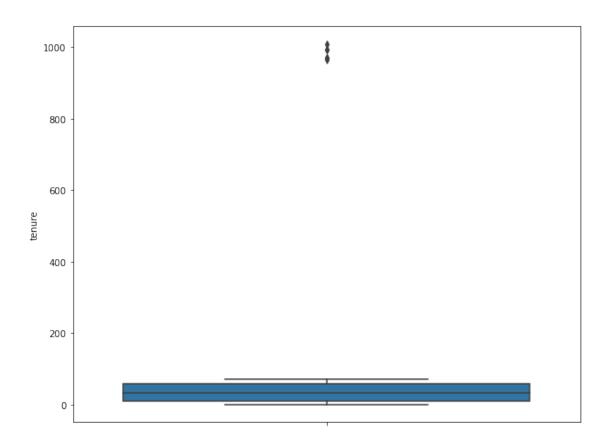


Answer: None of the above

0.0.7 Solution 8

```
[123]: churn2['tenure'].value_counts()
[123]: One
               20
       72
               15
       44
               11
                9
                9
       Four
       30
                1
       54
                1
       47
                1
       994
                1
       971
       Name: tenure, Length: 71, dtype: int64
[121]: churn2['tenure'].unique()
[121]: array(['One', '39', '2', '6', 'Four', '3', '70', '42', '11', '28', '72',
              '38', '64', '30', '49', '10', '57', '16', '54', '69', '25', '71',
```

```
'17', '21', '65', '51', '62', '9', '13', '44', '8', '68', '971',
              '63', '61', '48', '5', '32', '37', '31', '1008', '46', '36', '18',
              '34', '66', '22', '43', '29', '994', '47', '27', '55', '58', '59',
              '56', '52', '7', '12', '19', '45', '14', '53', '992', '15', '41',
              '40', '969', '67', '964', '50'], dtype=object)
[126]: churn2['tenure'].replace('One',1,inplace=True)
       churn2['tenure'].replace('Four',4,inplace=True)
[127]: churn2['tenure'].unique()
[127]: array([1, '39', '2', '6', 4, '3', '70', '42', '11', '28', '72', '38',
              '64', '30', '49', '10', '57', '16', '54', '69', '25', '71', '17',
              '21', '65', '51', '62', '9', '13', '44', '8', '68', '971', '63',
              '61', '48', '5', '32', '37', '31', '1008', '46', '36', '18', '34',
              '66', '22', '43', '29', '994', '47', '27', '55', '58', '59', '56',
              '52', '7', '12', '19', '45', '14', '53', '992', '15', '41', '40',
              '969', '67', '964', '50'], dtype=object)
[128]: churn2['tenure']=churn2['tenure'].astype(int)
[129]: churn2['tenure'].unique()
[129]: array([
                      39,
                              2,
                                    6,
                                          4,
                                                3,
                                                      70,
                                                            42,
                                                                         28,
                                                                               72,
                 1,
                                                                  11,
                38,
                      64,
                                   49,
                                                                         25,
                             30,
                                         10,
                                                57,
                                                      16,
                                                            54,
                                                                  69,
                                                                               71,
                                                                              971,
                17,
                             65,
                                         62,
                                                            44,
                                                                         68,
                      21,
                                   51,
                                                9,
                                                      13,
                                                                   8,
                63,
                      61,
                             48,
                                    5,
                                         32,
                                                37,
                                                      31, 1008,
                                                                  46,
                                                                         36,
                                                                               18,
                                         29,
                34,
                       66,
                             22,
                                   43,
                                              994,
                                                      47,
                                                            27,
                                                                  55,
                                                                         58,
                                                                               59,
                             7,
                56,
                      52,
                                   12,
                                         19,
                                                      14,
                                                            53,
                                                                 992,
                                                                         15,
                                                                               41,
                                                45,
                40,
                                         50])
                     969,
                             67,
                                  964,
[132]: plt.figure(figsize=(10,8))
       sns.boxplot(y=churn2['tenure'])
[132]: <AxesSubplot:ylabel='tenure'>
```



[134]:	churn2	churn2.describe()									
[134]:		tenure	MonthlyCharges	TotalCharges	SeniorCitizen						
	count	257.000000	247.000000	242.000000	252.000000						
	mean	55.618677	62.473482	2267.953719	0.134921						
	std	145.797814	31.126525	2270.876564	0.342319						
	min	1.000000	3.500000	18.850000	0.000000						
	25%	9.000000	25.700000	450.687500	0.000000						
	50%	34.000000	70.300000	1313.025000	0.000000						
	75%	58.000000	88.325000	3691.187500	0.000000						
	max	1008.000000	115.100000	8337.450000	1.000000						

Answer: Median, as the Mean is heavily affected due to the outliers.

0.0.8 Solution 9

Answer: churn['SeniorCitizen'].fillna(churn['SeniorCitizen'].mode()[0],inplace = True)SeniorCitizen is a categorical variable, so we need to use the mode.

0.0.9 Solution 10

```
[167]: | yeschurn=churn2[churn2['Churn']=='Yes']
      nochurn=churn2[churn2['Churn']=='No']
[168]:
[169]:
       yeschurn
[169]:
             customerID
                          tenure
                                         Contract PaperlessBilling
             8260-NGFNY
       0
                                   Month-to-month
                                                                  No
       1
             2359-QWQUL
                              39
                                         One year
                                                                 Yes
       2
             6598/RFFVI
                               2
                                                                  No
                                         One year
       3
             IXSTS-8780
                               6
                                  Month-to-month
                                                                 Yes
       7
             7547-EKNFS
                              42
                                  Month-to-month
                                                                 Yes
       . .
       245
            4088-YLDSU
                              55
                                         One year
                                                                 Yes
       251
             4625-EWPTF
                               8
                                  Month-to-month
                                                                 Yes
       252
                                                                 Yes
             8111-RKSPX
                                  Month-to-month
       254
            5192-EBGOV
                                  Month-to-month
                                                                 Yes
                                  Month-to-month
            9318-NKNFC
       256
                                                                 Yes
                          PaymentMethod MonthlyCharges
                                                           TotalCharges
                                                                           gender
       0
                           Mailed check
                                                    25.20
                                                                   25.20
                                                                          Female
       1
               Credit card (automatic)
                                                   104.70
                                                                 4134.85
                                                                           Female
       2
               Credit card (automatic)
                                                    19.30
                                                                   28.30
                                                                             Male
       3
                      Electronic check
                                                    90.10
                                                                  521.30
                                                                          Female
       7
             Bank transfer (automatic)
                                                                 3959.35
                                                    95.25
                                                                             Male
       245
                       Electronic check
                                                   104.15
                                                                 5743.05
                                                                             Male
       251
                      Electronic check
                                                    30.45
                                                                  226.45
                                                                             Male
       252
             Bank transfer (automatic)
                                                    72.20
                                                                  305.55
                                                                             Male
       254
                       Electronic check
                                                                   85.70
                                                      NaN
                                                                           Female
       256
                           Mailed check
                                                    18.85
                                                                   18.85
                                                                             Male
             SeniorCitizen Partner
                                      ... PhoneService
                                                           MultipleLines
                        0.0
       0
                                 No
                                                       No phone service
                                                   No
       1
                        0.0
                                Yes
                                                  Yes
                                                                      No
                        0.0
                                                                      No
       2
                                 No
                                                  Yes
       3
                        0.0
                                                  Yes
                                                                     Yes
                                 No
       7
                        0.0
                                                                     Yes
                                Yes
                                                  Yes
       . .
                        •••
                                 •••
       245
                        0.0
                                Yes
                                                  Yes
                                                                     Yes
       251
                        0.0
                                 No
                                                       No phone service
                                                   No
       252
                        0.0
                                 No
                                                  Yes
                                                                     Yes
       254
                                                                      Yes
                        1.0
                                 No
                                                  Yes
       256
                        0.0
                                                                      No
                                 No
                                                  Yes
                                    OnlineSecurity
                                                             OnlineBackup
            InternetService
```

```
0
                 DSL
                                         No
                                                                No
1
         Fiber optic
                                        Yes
                                                                No
2
                       No internet service
                                             No internet service
3
         Fiber optic
                                         No
7
         Fiber optic
                                         No
                                                               Yes
245
         Fiber optic
                                         No
                                                               No
251
                 DSL
                                        Yes
                                                               No
252
         Fiber optic
                                         No
                                                               No
254
         Fiber optic
                                         No
                                                                No
256
                       No internet service No internet service
         DeviceProtection
                                     TechSupport
                                                           StreamingTV \
0
                        No
                                              No
                                                                     No
                       Yes
                                             Yes
1
                                                                    Yes
2
      No internet service
                            No internet service
                                                   No internet service
3
                        No
                                                                    Yes
                                              No
7
                       Yes
                                              No
                                                                    Yes
245
                                                                    Yes
                       Yes
                                             Yes
251
                        No
                                              No
                                                                     No
252
                                                                     Nο
                        No
                                              No
254
                                              No
                                                                    Yes
                        No
256
     No internet service
                            No internet service
                                                  No internet service
          StreamingMovies Churn
0
                        No
                             Yes
1
                       Yes
                             Yes
2
      No internet service
                             Yes
3
                        No
                             Yes
7
                        No
                             Yes
. .
245
                       Yes
                             Yes
251
                        No
                             Yes
252
                             Yes
                        No
254
                        No
                             Yes
256
     No internet service
                             Yes
[78 rows x 21 columns]
yeschurn['TotalCharges'].fillna(yeschurn['TotalCharges'].mean(), inplace = True)
nochurn['TotalCharges'].fillna(nochurn['TotalCharges'].mean(), inplace = True)
yeschurn['MonthlyCharges'].fillna(yeschurn['MonthlyCharges'].mean(), inplace = ___
nochurn['MonthlyCharges'].fillna(nochurn['MonthlyCharges'].mean(), inplace = ____
  ⊶True)
```

C:\ProgramData\Anaconda3\lib\site-packages\pandas\core\generic.py:6383:
SettingWithCopyWarning:

A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy return self._update_inplace(result)

[171]: yeschurn [171]: Contract PaperlessBilling customerID tenure 8260-NGFNY 1 Month-to-month 1 2359-QWQUL 39 One year Yes 2 2 6598/RFFVI One year No 3 IXSTS-8780 6 Month-to-month Yes 7 7547-EKNFS 42 Month-to-month Yes . . 4088-YLDSU 55 245 One year Yes 251 4625-EWPTF 8 Month-to-month Yes 252 8111-RKSPX Month-to-month Yes 254 5192-EBGOV Month-to-month Yes 256 9318-NKNFC Month-to-month Yes PaymentMethod MonthlyCharges TotalCharges gender 0 Mailed check 25,200 25.20 Female 1 Credit card (automatic) 104.700 4134.85 Female 2 Credit card (automatic) 19.300 28.30 Male 3 Electronic check 521.30 90.100 Female 7 Bank transfer (automatic) 95.250 3959.35 Male . . 245 Electronic check 104.150 5743.05 Male 251 Electronic check 30.450 226.45 Male 72.200 252 Bank transfer (automatic) 305.55 Male 254 Electronic check 71.436 85.70 Female Mailed check 256 18.850 18.85 Male SeniorCitizen Partner ... PhoneService MultipleLines 0 0.0 No phone service No No 1 0.0 Yes Yes No 2 0.0 Yes No No 3 0.0 No Yes Yes 7 0.0 Yes Yes Yes 245 0.0 Yes Yes Yes 251 0.0 No phone service No No 252 Yes 0.0 No Yes

Yes

Yes

254

1.0

No

```
256
                      0.0 No ...
                                              Yes
                                                                   No
           InternetService
                                  OnlineSecurity
                                                         OnlineBackup \
                       DSL
       0
                                              No
       1
               Fiber optic
                                             Yes
                                                                    No
       2
                            No internet service No internet service
       3
               Fiber optic
                                              No
       7
               Fiber optic
                                              No
                                                                   Yes
       245
               Fiber optic
                                              No
                                                                    No
       251
                       DSL
                                                                    No
                                             Yes
       252
               Fiber optic
                                              No
                                                                    No
       254
               Fiber optic
                                              No
                                                                    No
       256
                        No No internet service No internet service
                                          TechSupport
               DeviceProtection
                                                                StreamingTV \
                             No
                                                   No
       0
                                                                         No
       1
                             Yes
                                                   Yes
                                                                        Yes
       2
            No internet service
                                No internet service
                                                       No internet service
       3
                             No
                                                                        Yes
                                                   No
       7
                             Yes
                                                                        Yes
                                                   No
       245
                                                                        Yes
                             Yes
                                                   Yes
       251
                                                                         No
                             No
                                                   No
       252
                             No
                                                                         No
       254
                             No
                                                                        Yes
       256 No internet service No internet service No internet service
                StreamingMovies Churn
       0
                             No
                                   Yes
       1
                             Yes
                                   Yes
       2
                                   Yes
            No internet service
       3
                                   Yes
       7
                             No
                                   Yes
       . .
       245
                             Yes
                                   Yes
       251
                             No
                                   Yes
       252
                             No
                                   Yes
       254
                             No
                                   Yes
       256 No internet service
                                   Yes
       [78 rows x 21 columns]
[173]: nochurn
                                       Contract PaperlessBilling \
            customerID tenure
```

Yes

4 Month-to-month

[173]:

4

2674/MIAHT

```
6077-BDPXA
5
                      3 Month-to-month
                                                        Yes
6
     7929/SKFGK
                      70
                                Two year
                                                         No
8
     5854-KSRBJ
                      70
                                Two year
                                                         No
10
     1877-HKBQX
                      11
                                One year
                                                        Yes
. .
248
    3845-FXCYS
                       2
                          Month-to-month
                                                        Yes
249
     7690-KPNCU
                      64
                                One year
                                                        Yes
250
    2589-AYCRP
                      50
                                One year
                                                         No
    6922-NCEDI
                                One year
253
                      56
                                                        Yes
255
    8495-PRWFH
                      42
                         Month-to-month
                                                         No
                 PaymentMethod MonthlyCharges TotalCharges gender
4
                   Mailed check
                                           80.30
                                                         324.20
                                                                 Female
5
              Electronic check
                                           70.15
                                                         194.20
                                                                Female
       Credit card (automatic)
                                                        8244.30
6
                                          114.30
                                                                    Male
8
                   Mailed check
                                           25.40
                                                        1782.05
                                                                    Male
                   Mailed check
10
                                           54.60
                                                         617.85
                                                                 Female
. .
248
              Electronic check
                                           19.65
                                                          31.20
                                                                    Male
249
       Credit card (automatic)
                                           73.05
                                                        4688.65
                                                                    Male
    Bank transfer (automatic)
250
                                           19.75
                                                         989.05
                                                                 Female
253
                   Mailed check
                                           21.20
                                                                    Male
                                                        1238.65
255
              Electronic check
                                           55.65
                                                        2421.75 Female
     SeniorCitizen Partner ... PhoneService MultipleLines InternetService \
4
               0.0
                         No
                                         Yes
                                                        Yes
                                                                Fiber optic
               0.0
                                                                Fiber optic
5
                         No
                                         Yes
                                                         No
6
                0.0
                                         Yes
                                                        Yes
                                                                Fiber optic
                        Yes ...
8
                0.0
                        Yes
                                         Yes
                                                        Yes
                                                                          No
                                                                         DSL
10
                0.0
                                         Yes
                                                         No
                         No
. .
                      ... ...
248
                0.0
                         No
                                         Yes
                                                         No
                                                                          No
               0.0
                                                                         DSL
249
                        Yes
                                         Yes
                                                         No
250
                0.0
                         No
                                         Yes
                                                         No
                                                                          No
253
                0.0
                                         Yes
                         No
                                                         No
                                                                          No
255
                1.0
                         No
                                         Yes
                                                        Yes
                                                                         DSL
          OnlineSecurity
                                   OnlineBackup
                                                     DeviceProtection
4
                       No
                                            Yes
                                                                    No
5
                       No
                                             No
                                                                    No
6
                      Yes
                                            Yes
                                                                   Yes
8
     No internet service No internet service
                                                 No internet service
10
                      Yes
                                             No
. .
248
    No internet service No internet service
                                                 No internet service
249
                      Yes
                                             No
                                                                   Yes
250
   No internet service No internet service
                                                 No internet service
```

```
253
           No internet service No internet service
                                                      No internet service
       255
                                                                        Yes
                    TechSupport
                                          StreamingTV
                                                            StreamingMovies Churn
       4
                             No
                                                   No
                                                                               No
       5
                                                                         No
                             No
                                                   No
                                                                               No
       6
                            Yes
                                                  Yes
                                                                        Yes
                                                                               No
       8
            No internet service No internet service
                                                       No internet service
       10
                            Yes
                                                   No
                                                                         No
                                                                               No
       . .
       248
            No internet service
                                 No internet service
                                                       No internet service
                                                                               No
       249
                                                  Yes
                                                                        Yes
       250
           No internet service
                                 No internet service
                                                       No internet service
                                                                               No
       253
            No internet service No internet service
                                                       No internet service
                                                                               No
       255
                             No
                                                                         No
                                                   No
                                                                               No
       [179 rows x 21 columns]
[193]: (len(yeschurn['MonthlyCharges'])*yeschurn['MonthlyCharges'].
        -mean()+len(nochurn['MonthlyCharges'])*nochurn['MonthlyCharges'].mean())/
```

[193]: 62.47165699936657

```
[194]: (len(yeschurn['TotalCharges'])*yeschurn['TotalCharges'].

→mean()+len(nochurn['TotalCharges'])*nochurn['TotalCharges'].mean())/

→(len(nochurn['TotalCharges'])+len(yeschurn['TotalCharges']))
```

[194]: 2275.439863370537

Answer: 2275.439, 62.471