```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
df = pd.read csv("F:/AI Projects/11.WA Fn-UseC -Telco-Customer-
Churn Project/WA Fn-UseC -Telco-Customer-Churn new ad.csv")
df
                    gender SeniorCitizen Partner Dependents
       customerID
                                                                 tenure \
0
       7590 - VHVEG
                    Female
                                         0
                                                Yes
                                                             No
                                                                      1
1
                      Male
                                         0
       5575 - GNVDE
                                                 No
                                                             No
                                                                      34
2
                      Male
                                          0
                                                                      2
       3668-QPYBK
                                                 No
                                                             No
3
       7795-CF0CW
                      Male
                                          0
                                                 No
                                                             No
                                                                      45
4
       9237-HQITU
                                          0
                                                                       2
                    Female
                                                 No
                                                             No
                                                            . . .
                                                 . . .
       7549-MYXPK
10318
                    Female
                                          0
                                                 No
                                                             No
                                                                      16
10319
       3948-BLXYF
                    Female
                                          0
                                                 No
                                                            Yes
                                                                      66
10320
                      Male
                                          1
                                                                      45
      3149-NPXCN
                                                 No
                                                             No
10321
       5140-PTXKA
                      Male
                                          0
                                                                      69
                                                 No
                                                            Yes
10322 4641-NJXUX
                      Male
                                          1
                                                 No
                                                             No
                                                                      15
      PhoneService
                        MultipleLines InternetService
OnlineSecurity
                    No phone service
                                                    DSL
0
                 No
No
                                                    DSL
1
                Yes
                                    No
Yes
2
                Yes
                                    No
                                                    DSL
Yes
3
                 No
                     No phone service
                                                    DSL
Yes
4
                Yes
                                    No
                                            Fiber optic
No
. . .
. . .
                Yes
                                            Fiber optic No internet
10318
                                   Yes
service
10319
                Yes
                                    No
                                                     No
Yes
10320
                Yes
                                   Yes
                                            Fiber optic No internet
service
10321
                Yes
                     No phone service
                                                     No
No
10322
                Yes
                                            Fiber optic
                                    No
No
                DeviceProtection
                                            TechSupport
StreamingTV
                               No
                                                     No
```

No 1					
No		,	/	NI -	
2 No		•••	res	NO	
No			No	No	
3 Yes Yes No 4 No N			110	110	
4 No internet service No internet service No internet service logical service  10318 No internet service No internet service No internet service logical service  10319 No No No Yes  Yes 10320 No internet service No internet service No internet service logical service  10321 No Yes  Yes 10322 No No No Yes  StreamingMovies One year No No Yes  Month-to-month Yes 1 No One year No No No Honth-to-month Yes 1 No No One year No No No Honth-to-month Yes 1 No Month-to-month Yes 1 No Month-to-month Yes 1 No No No No Honth-to-month Yes 1 No No No Honth-to-month Yes 1 No No No Honth-to-month Yes 1 No No Honth-to-month Yes 1 No Honth-to-month Yes 2 No Honth-to-month Yes 2 No Honth-to-month Yes 2 No Honth-to-month Yes 3 Bank transfer (automatic) 42.30 1840.75 No Honth-to-month Yes 3 Bank transfer (automatic) 42.30 1840.75 No Honth-to-month Yes 3 Bank transfer (automatic) 42.30 1840.75 No Honth-to-month Yes 3 Bank transfer (automatic) 42.30 1840.75 No Honth-to-month Yes 3 Bank transfer (automatic) 42.30 1840.75 No Honth-to-month Yes 4 Electronic check 70.70 151.65 Yes 10310 Credit card (automatic) 44.80 1600.95 No Honth-to-month Honth-to-month Yes 10320 Credit card (automatic) 44.80 1600.95 No Honth-to-month Honth-to-month Honth-to-month Yes 10321 Mailed check 100.85 399.25 No Honth-to-month Honth-to-month Yes 10322 Electronic check 100.85 399.25 No Honth-to-month Honth-to-month Honth-to-month Yes 10322 Electronic check 100.85 399.25 No Honth-to-month Honth-to-month Honth-to-month Yes 10322 Electronic check 100.85 399.25 No Honth-to-month Honth-to-month Honth-to-month Yes 10322 Electronic check 100.85 399.25 No Honth-to-month Honth-to-month Honth-to-month Yes 10322 Electronic check 100.85 399.25 No Honth-to-month Honth-t			′es	Yes	
No					
10318     No internet service   No   Yes   Yes	4		No	No	
10318   No internet service   No internet service   No internet service   10319     No   No   No   Yes   10320   No internet service   No internet service   No internet service   10321     No   Yes   Yes	No				
10318 No internet service No internet service lo319 No No No Yes lo320 No internet service No internet service lo321 No Yes lo322 No No No Yes lo322 No No No No No los los los los los los los los los lo			• •		
No					
10319			ice No intern	net service	No internet
Yes         10320 No internet service         Contract PaperlessBilling No			No	No	
10320   No internet service   No internet service     10321		• • •	NO	NO	
Service		No internet serv	ice No intern	net service	No internet
No			icc No intern	ice service	NO INCCINCE
Yes         10322         No         No           Yes         StreamingMovies         Contract PaperlessBilling \ No         No           0         No         Month-to-month Yes         No           1         No         One year No           2         No         Month-to-month Yes           3         No         One year No           4         No         Month-to-month Yes                10318         No internet service Two year No         No           10320         No internet service One year No         No           10321         Yes Month-to-month Yes           10322         Yes Month-to-month Yes           PaymentMethod MonthlyCharges Month-to-month Yes         TotalCharges Churn Onth Yes           0         Electronic check 29.85 29.85 No           1         Mailed check 56.95 1889.5 No           2         Mailed check 56.95 1889.5 No           3         Bank transfer (automatic) 42.30 1840.75 No           4         Electronic check 70.70 151.65 Yes               10318         Mailed check 20.40 292.4 No           10319         Mailed check 74.80 1821.2 No           10320         Credi			No	Yes	
StreamingMovies					
StreamingMovies	10322		No	No	
0         No         Month-to-month One year         Yes           1         No         One year         No           2         No         Month-to-month Yes           3         No         One year         No           4         No         Month-to-month Yes                10318         No internet service Two year No         No           10319         Yes One year No         No           10321         Yes Month-to-month Yes           10322         Yes Month-to-month Yes           PaymentMethod MonthlyCharges Month-to-month Yes         29.85 No           1         Mailed Check S6.95 1889.5 No           2         Mailed Check S6.95 1889.5 No           3         Bank transfer (automatic) 42.30 1840.75 No           4         Electronic Check 70.70 151.65 Yes               10318         Mailed Check 20.40 292.4 No           10319         Mailed check 74.80 1821.2 No           10320         Credit card (automatic) 24.80 1600.95 No           10321         Mailed check 100.85 399.25 No           10322         Electronic Check 101.35 1218.55 Yes	Yes				
0         No         Month-to-month One year         Yes           1         No         One year         No           2         No         Month-to-month Yes           3         No         One year         No           4         No         Month-to-month Yes                10318         No internet service Two year No         No           10319         Yes One year No         No           10321         Yes Month-to-month Yes           10322         Yes Month-to-month Yes           PaymentMethod MonthlyCharges Month-to-month Yes         29.85 No           1         Mailed Check S6.95 1889.5 No           2         Mailed Check S6.95 1889.5 No           3         Bank transfer (automatic) 42.30 1840.75 No           4         Electronic Check 70.70 151.65 Yes               10318         Mailed Check 20.40 292.4 No           10319         Mailed check 74.80 1821.2 No           10320         Credit card (automatic) 24.80 1600.95 No           10321         Mailed check 100.85 399.25 No           10322         Electronic Check 101.35 1218.55 Yes			_		
1         No         One year         No           2         No         Month-to-month         Yes           3         No         One year         No           4         No         Month-to-month         Yes                 10318         No internet service         Two year         No           10319         Yes         One year         No           10320         No internet service         One year         No           10321         Yes         Month-to-month         Yes           10322         Mailed check         29.85         29.85         No           10         Electronic check         29.85         1889.5         No           10         Mailed check         53.85         108.15         Yes           3         Bank transfer (automatic)         42.30         1840.75         No	0				_
2         No         Month-to-month Month - to-month -					
No	2				
4         No         Month-to-month         Yes                 10318         No internet service         Two year         No           10319         Yes         One year         No           10320         No internet service         One year         No           10321         Yes         Month-to-month         Yes           10322         Yes         Month-to-month         Yes           10322         PaymentMethod MonthlyCharges         TotalCharges Churn           10         Electronic check         29.85         29.85         No           1         Mailed check         56.95         1889.5         No           1         Mailed check         53.85         108.15         Yes           3         Bank transfer (automatic)         42.30         1840.75         No           4         Electronic check         70.70         151.65         Yes                  10318         Mailed check         20.40         292.4         No           10320         Credit card (automatic)         24.80         1600.95         No	3				
10318   No internet service   Two year   No	4				
10318         No internet service         Two year         No           10319         Yes         One year         No           10320         No internet service         One year         No           10321         Yes         Month-to-month         Yes           10322         Yes         Month-to-month         Yes           10322         Yes         Month-to-month         Yes           10322         PaymentMethod MonthlyCharges         TotalCharges Churn           10         Electronic check         29.85         29.85         No           1         Mailed check         56.95         1889.5         No           2         Mailed check         53.85         108.15         Yes           3         Bank transfer (automatic)         42.30         1840.75         No           4         Electronic check         70.70         151.65         Yes                  10318         Mailed check         20.40         292.4         No           10319         Mailed check         74.80         1821.2         No           10320         Credit card (automatic)         24.80         1600.					
10319         Yes         One year         No           10320         No internet service         One year         No           10321         Yes         Month-to-month         Yes           10322         Yes         Month-to-month         Yes           PaymentMethod MonthlyCharges         TotalCharges Churn         Churn           0         Electronic check         29.85         29.85         No           1         Mailed check         56.95         1889.5         No           2         Mailed check         53.85         108.15         Yes           3         Bank transfer (automatic)         42.30         1840.75         No           4         Electronic check         70.70         151.65         Yes                  10318         Mailed check         20.40         292.4         No           10319         Mailed check         74.80         1821.2         No           10320         Credit card (automatic)         24.80         1600.95         No           10321         Mailed check         100.85         399.25         No           10322         Electronic check <td></td> <td></td> <td></td> <td></td> <td></td>					
10320         No internet service         One year         No           10321         Yes Month-to-month         Yes           10322         Yes Month-to-month         Yes           PaymentMethod MonthlyCharges         TotalCharges Churn           0         Electronic check         29.85         29.85         No           1         Mailed check         56.95         1889.5         No           2         Mailed check         53.85         108.15         Yes           3         Bank transfer (automatic)         42.30         1840.75         No           4         Electronic check         70.70         151.65         Yes                  10318         Mailed check         20.40         292.4         No           10319         Mailed check         74.80         1821.2         No           10320         Credit card (automatic)         24.80         1600.95         No           10321         Mailed check         100.85         399.25         No           10322         Electronic check         101.35         1218.55         Yes					
Total					
PaymentMethod MonthlyCharges TotalCharges Churn  0 Electronic check 29.85 29.85 No  1 Mailed check 56.95 1889.5 No  2 Mailed check 53.85 108.15 Yes  3 Bank transfer (automatic) 42.30 1840.75 No  4 Electronic check 70.70 151.65 Yes   10318 Mailed check 20.40 292.4 No  10319 Mailed check 74.80 1821.2 No  10320 Credit card (automatic) 24.80 1600.95 No  10321 Mailed check 100.85 399.25 No  10322 Electronic check 101.35 1218.55 Yes	10321	Yes 1			Yes
0       Electronic check       29.85       29.85       No         1       Mailed check       56.95       1889.5       No         2       Mailed check       53.85       108.15       Yes         3       Bank transfer (automatic)       42.30       1840.75       No         4       Electronic check       70.70       151.65       Yes                 10318       Mailed check       20.40       292.4       No         10319       Mailed check       74.80       1821.2       No         10320       Credit card (automatic)       24.80       1600.95       No         10321       Mailed check       100.85       399.25       No         10322       Electronic check       101.35       1218.55       Yes	10322	Yes 1	Nonth-to-month	1	Yes
0       Electronic check       29.85       29.85       No         1       Mailed check       56.95       1889.5       No         2       Mailed check       53.85       108.15       Yes         3       Bank transfer (automatic)       42.30       1840.75       No         4       Electronic check       70.70       151.65       Yes                 10318       Mailed check       20.40       292.4       No         10319       Mailed check       74.80       1821.2       No         10320       Credit card (automatic)       24.80       1600.95       No         10321       Mailed check       100.85       399.25       No         10322       Electronic check       101.35       1218.55       Yes					
1       Mailed check       56.95       1889.5       No         2       Mailed check       53.85       108.15       Yes         3       Bank transfer (automatic)       42.30       1840.75       No         4       Electronic check       70.70       151.65       Yes                 10318       Mailed check       20.40       292.4       No         10319       Mailed check       74.80       1821.2       No         10320       Credit card (automatic)       24.80       1600.95       No         10321       Mailed check       100.85       399.25       No         10322       Electronic check       101.35       1218.55       Yes					
4 Electronic check 70.70 151.65 Yes 10318 Mailed check 20.40 292.4 No 10319 Mailed check 74.80 1821.2 No 10320 Credit card (automatic) 24.80 1600.95 No 10321 Mailed check 100.85 399.25 No 10322 Electronic check 101.35 1218.55 Yes	0				
4 Electronic check 70.70 151.65 Yes 10318 Mailed check 20.40 292.4 No 10319 Mailed check 74.80 1821.2 No 10320 Credit card (automatic) 24.80 1600.95 No 10321 Mailed check 100.85 399.25 No 10322 Electronic check 101.35 1218.55 Yes	1				
4 Electronic check 70.70 151.65 Yes 10318 Mailed check 20.40 292.4 No 10319 Mailed check 74.80 1821.2 No 10320 Credit card (automatic) 24.80 1600.95 No 10321 Mailed check 100.85 399.25 No 10322 Electronic check 101.35 1218.55 Yes	2				
10318 Mailed check 20.40 292.4 No 10319 Mailed check 74.80 1821.2 No 10320 Credit card (automatic) 24.80 1600.95 No 10321 Mailed check 100.85 399.25 No 10322 Electronic check 101.35 1218.55 Yes	3	•	•		
10318       Mailed check       20.40       292.4       No         10319       Mailed check       74.80       1821.2       No         10320       Credit card (automatic)       24.80       1600.95       No         10321       Mailed check       100.85       399.25       No         10322       Electronic check       101.35       1218.55       Yes	4	Electronic cl	neck	/0.70	
10319       Mailed check       74.80       1821.2       No         10320       Credit card (automatic)       24.80       1600.95       No         10321       Mailed check       100.85       399.25       No         10322       Electronic check       101.35       1218.55       Yes		M - 11 - 1			
10320       Credit card (automatic)       24.80       1600.95       No         10321       Mailed check       100.85       399.25       No         10322       Electronic check       101.35       1218.55       Yes					
10321       Mailed check       100.85       399.25       No         10322       Electronic check       101.35       1218.55       Yes					
10322 Electronic check 101.35 1218.55 Yes			•		
[10323 rows x 21 columns]	10322	Electronic C	ieck I	101.33	1210.33 Yes
[	[10323	rows x 21 columns1			
	[ 10323	. 55 X 21 CO CO			

```
df.head(2)
   customerID gender SeniorCitizen Partner Dependents tenure
PhoneService \
  7590 - VHVEG
              Female
                                          Yes
                                                       No
                                                                1
No
1 5575-GNVDE
                 Male
                                    0
                                           No
                                                       No
                                                               34
Yes
      MultipleLines InternetService OnlineSecurity ...
DeviceProtection \
                                 DSL
0 No phone service
                                                  No
No
                                 DSL
1
                 No
                                                 Yes
Yes
  TechSupport StreamingTV StreamingMovies
                                                   Contract
PaperlessBilling
                        No
                                            Month-to-month
           No
                                        No
Yes
1
           No
                        No
                                        No
                                                   One year
No
      PaymentMethod MonthlyCharges
                                     TotalCharges Churn
   Electronic check
                              29.85
                                            29.85
                                                      No
1
       Mailed check
                              56.95
                                            1889.5
                                                      No
[2 rows x 21 columns]
df.info()
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10323 entries, 0 to 10322
Data columns (total 21 columns):
#
     Column
                        Non-Null Count
                                        Dtype
 0
     customerID
                        10323 non-null
                                        object
 1
     gender
                        10323 non-null
                                        object
 2
     SeniorCitizen
                        10323 non-null
                                        int64
 3
     Partner
                        10323 non-null
                                        object
 4
     Dependents
                        10323 non-null
                                        object
 5
     tenure
                        10323 non-null
                                        int64
 6
     PhoneService
                        10323 non-null
                                        object
 7
     MultipleLines
                        10323 non-null
                                        object
 8
     InternetService
                        10323 non-null
                                        object
                                        object
 9
     OnlineSecurity
                        10323 non-null
 10
     OnlineBackup
                        10323 non-null
                                        object
     DeviceProtection
 11
                        10323 non-null
                                        object
 12
     TechSupport
                        10323 non-null
                                        object
 13
     StreamingTV
                        10323 non-null
                                        object
```

```
14 StreamingMovies
                       10323 non-null
                                       object
 15 Contract
                       10323 non-null
                                       object
 16 PaperlessBilling
                       10323 non-null
                                       object
 17 PaymentMethod
                       10323 non-null
                                       object
 18 MonthlyCharges
                       10323 non-null
                                      float64
 19
    TotalCharges
                       10295 non-null
                                       object
 20
    Churn
                       10323 non-null
                                       object
dtypes: float64(1), int64(2), object(18)
memory usage: 1.7+ MB
df.columns
Index(['customerID', 'gender', 'SeniorCitizen', 'Partner',
'Dependents',
       'tenure', 'PhoneService', 'MultipleLines', 'InternetService',
       'OnlineSecurity', 'OnlineBackup', 'DeviceProtection',
'TechSupport',
       'StreamingTV', 'StreamingMovies', 'Contract',
'PaperlessBilling'
       'PaymentMethod', 'MonthlyCharges', 'TotalCharges', 'Churn'],
      dtype='object')
# Replacing blanks with 0 as tenure is 0 and no totoal charges are
record
df["TotalCharges"] = df["TotalCharges"].replace(" ", "0")
df["TotalCharges"] = df["TotalCharges"].astype("float")
df.info()
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10323 entries, 0 to 10322
Data columns (total 21 columns):
     Column
                       Non-Null Count
 #
                                       Dtype
     -----
 0
     customerID
                       10323 non-null
                                       object
                       10323 non-null
 1
                                       object
     gender
 2
     SeniorCitizen
                       10323 non-null
                                       int64
 3
                       10323 non-null
                                       object
     Partner
 4
     Dependents
                       10323 non-null
                                      object
 5
                       10323 non-null
     tenure
                                      int64
 6
     PhoneService
                       10323 non-null
                                      object
 7
     MultipleLines
                       10323 non-null
                                       object
 8
     InternetService
                       10323 non-null
                                       obiect
 9
     OnlineSecurity
                       10323 non-null
                                       object
 10 OnlineBackup
                       10323 non-null
                                       object
    DeviceProtection 10323 non-null
 11
                                       object
 12 TechSupport
                       10323 non-null
                                       object
 13
    StreamingTV
                       10323 non-null
                                       object
 14 StreamingMovies
                       10323 non-null
                                       object
    Contract
 15
                       10323 non-null
                                       object
```

```
16 PaperlessBilling 10323 non-null
                                      object
    PaymentMethod
                      10323 non-null
                                      object
 17
 18 MonthlyCharges
                      10323 non-null
                                      float64
 19
    TotalCharges
                      10295 non-null
                                      float64
                      10323 non-null object
20 Churn
dtypes: float64(2), int64(2), object(17)
memory usage: 1.7+ MB
df.isnull()
      customerID gender SeniorCitizen Partner Dependents tenure
/
0
           False
                   False
                                  False
                                           False
                                                       False
                                                               False
1
           False
                   False
                                  False
                                           False
                                                       False
                                                               False
2
           False
                   False
                                  False
                                           False
                                                       False
                                                               False
3
           False False
                                  False
                                                               False
                                           False
                                                       False
            False
                   False
                                  False
                                                               False
                                           False
                                                       False
                                                                 . . .
10318
           False
                   False
                                  False
                                           False
                                                       False
                                                               False
10319
           False
                   False
                                  False
                                           False
                                                       False
                                                               False
10320
           False
                   False
                                  False
                                           False
                                                       False
                                                               False
10321
                                  False
           False
                   False
                                           False
                                                       False
                                                               False
10322
           False
                   False
                                  False
                                           False
                                                       False
                                                               False
       PhoneService
                    MultipleLines InternetService
OnlineSecurity ...
             False
                            False
                                             False
False
             False
                            False
                                             False
1
False
              False
                            False
                                             False
False
3
              False
                            False
                                             False
False
4
              False
                            False
                                             False
False
. . .
10318
             False
                            False
                                             False
False
```

10210		Го1 оо	Гајаа	Галаа		
10319 False 10320 False 10321 False 10322 False		False	False	False		
		False	False	False	e	
		False	False	False	e	
		False	False	False		
		Protection	TechSupport	StreamingTV Str	eamingMovies	
Contra	ct \	- 1	- 1	F 1	F 3	
0 Folso		False	False	False	False	
False 1		False	False	False	False	
False		Tacsc	14130	racsc	racsc	
2		False	False	False	False	
False						
3		False	False	False	False	
False		F-1	F-1	F-1	F-1	
4 False		False	False	False	False	
10318		False	False	False	False	
False		- 1	- 1	F 1	F 1	
10319		False	False	False	False	
False 10320		False	False	False	False	
False		Tacsc	racse	1 4 (3)	racsc	
10321		False	False	False	False	
False		_	_			
10322		False	False	False	False	
False						
Churn	Paperle	essBilling	PaymentMethod	d MonthlyCharges	TotalCharges	
0		False	False	e False	False	
False		. 4 . 5 .	. 4150		. 4.50	
1		False	False	e False	False	
False		- 1	- 1	- 1	<b>-</b> 1	
2 False		False	False	e False	False	
3		False	False	e False	False	
False 4		Falco	False		Ealco	
4 False		False	гасы	e False	False	
10318		False	False	e False	False	

False				
10319	False	False	False	False
False				
10320	False	False	False	False
False				
10321	False	False	False	False
False				
10322	False	False	False	False
False				

[10323 rows x 21 columns]

df.isnull().sum()

customerID	0
gender	0
SeniorCitizen	0
Partner	0
Dependents	0
tenure	0
PhoneService	0
MultipleLines	0
InternetService	0
OnlineSecurity	0
OnlineBackup	0
DeviceProtection	0
TechSupport	0
StreamingTV	0
StreamingMovies	0
Contract	0
PaperlessBilling	0
PaymentMethod	0
MonthlyCharges	0
TotalCharges	28
Churn	0
dtyne: int64	

dtype: int64

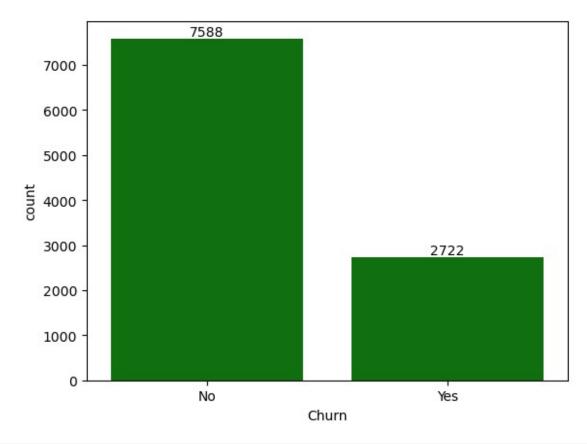
df.describe()

	SeniorCitizen	tenure	MonthlyCharges	TotalCharges
count	10323.000000	10323.000000	10323.000000	10295.000000
mean	0.203139	32.284317	64.818493	2275.535624
std	0.402354	24.574950	30.113270	2264.457186
min	0.00000	0.000000	18.250000	0.00000
25%	0.00000	9.000000	35.450000	398.900000
50%	0.00000	29.000000	70.450000	1389.200000
75%	0.000000	55.000000	89.900000	3780.625000
max	1.000000	72.000000	118.750000	8684.800000

df["customerID"].duplicated().sum()

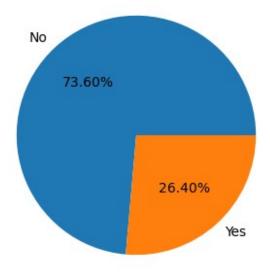
```
13
df = df.drop duplicates(subset="customerID")
df["customerID"].duplicated().sum()
0
duplicate columns = [col for col in df.columns if
df[col].duplicated().any()]
print(f"Columns with duplicate values: {duplicate_columns}")
print(f"Number of columns with duplicate values:
{len(duplicate columns)}")
df cleaned = df.drop duplicates(subset=duplicate columns)
Columns with duplicate values: ['gender', 'SeniorCitizen', 'Partner', 'Dependents', 'tenure', 'PhoneService', 'MultipleLines',
'InternetService', 'OnlineSecurity', 'OnlineBackup',
'DeviceProtection', 'TechSupport', 'StreamingTV', 'StreamingMovies',
'Contract', 'PaperlessBilling', 'PaymentMethod', 'MonthlyCharges',
'TotalCharges', 'Churn']
Number of columns with duplicate values: 20
def conv(value):
    if value ==1:
         return "yes"
    else:
         return "no"
df["SeniorCitizen"] = df["SeniorCitizen"].apply(conv)
C:\Users\user\AppData\Local\Temp\ipykernel 12504\2155067224.py:6:
SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row indexer,col indexer] = value instead
See the caveats in the documentation:
https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#
returning-a-view-versus-a-copy
  df["SeniorCitizen"] = df["SeniorCitizen"].apply(conv)
# converting 0 and 1 values of senior citizen to yes/no make it easier
to undrstand
df.head()
   customerID gender SeniorCitizen Partner Dependents tenure
PhoneService \
  7590-VHVEG Female
                                     no
                                             Yes
                                                           No
No
```

```
1 5575-GNVDE
                 Male
                                           No
                                                       No
                                                               34
                                   no
Yes
2 3668-QPYBK
                  Male
                                   no
                                           No
                                                       No
                                                                2
Yes
3 7795-CF0CW
                 Male
                                   no
                                           No
                                                       No
                                                               45
No
                Female
                                                       No
                                                                2
4 9237-HQITU
                                           No
                                   no
Yes
      MultipleLines InternetService OnlineSecurity ...
DeviceProtection
0 No phone service
                                  DSL
                                                  No
No
                                  DSL
1
                  No
                                                 Yes
Yes
2
                  No
                                  DSL
                                                 Yes
No
3 No phone service
                                 DSL
                                                 Yes
Yes
                         Fiber optic
4
                  No
                                                  No ...
No
  TechSupport StreamingTV StreamingMovies
                                                   Contract
PaperlessBilling \
                        No
                                             Month-to-month
           No
                                         No
Yes
1
           No
                        No
                                         No
                                                    One year
No
2
           No
                        No
                                             Month-to-month
                                         No
Yes
3
          Yes
                        No
                                         No
                                                    One year
No
           No
                                             Month-to-month
4
                        No
                                         No
Yes
                PaymentMethod MonthlyCharges
                                              TotalCharges
                                                              Churn
            Electronic check
                                        29.85
0
                                                       29.85
                                                                 No
1
                 Mailed check
                                        56.95
                                                     1889.50
                                                                 No
2
                 Mailed check
                                        53.85
                                                      108.15
                                                                Yes
3
   Bank transfer (automatic)
                                        42.30
                                                     1840.75
                                                                 No
            Electronic check
4
                                        70.70
                                                      151.65
                                                                Yes
[5 rows x 21 columns]
ax = sns.countplot(x = df["Churn"], data = df, color = "green")
ax.bar label(ax.containers[0])
plt.show()
```



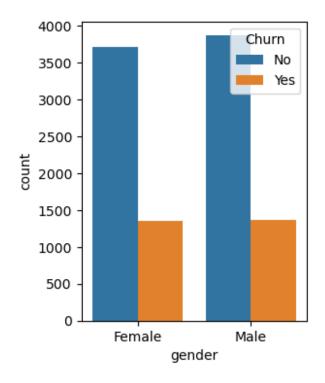
```
plt.figure(figsize = (4,4))
gb = df.groupby("Churn").agg({"Churn":"count"})
plt.pie(gb["Churn"], labels = gb.index, autopct = "%1.2f%%")
plt.title("Count of customers by Churn", fontsize = 10)
plt.show()
```

## Count of customers by Churn

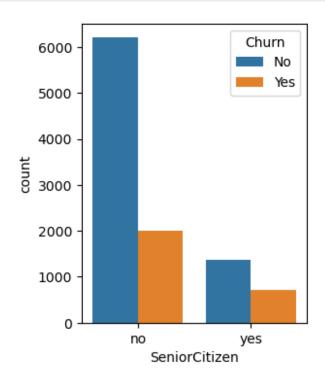


```
# From the given pie chart we can conclude that 25.54% of our
customers have churned
# out not let's explore the reason behind it.

plt.figure(figsize = (3,4))
sns.countplot( x= "gender", data=df, hue = "Churn")
plt.show()
```



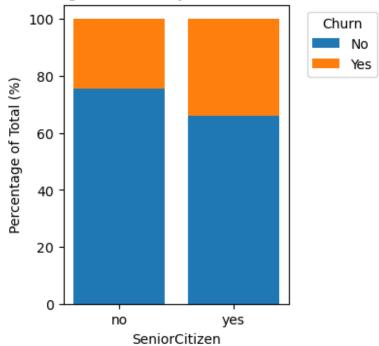
```
plt.figure(figsize = (3,4))
sns.countplot( x= "SeniorCitizen", data=df, hue = "Churn")
plt.show()
```



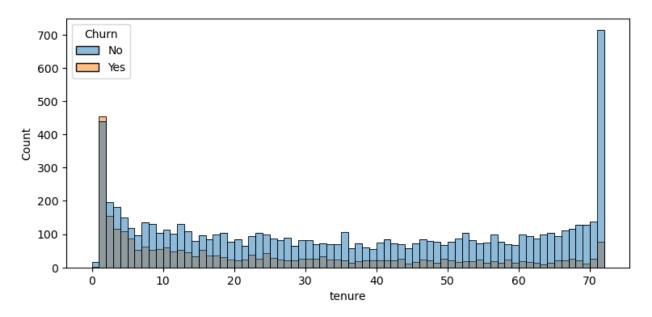
```
# Step 1: Calculate the counts and percentage of total for each
category
# Create a crosstab to count occurrences for each combination of
SeniorCitizen and Churn
count data = pd.crosstab(df['SeniorCitizen'], df['Churn'])
# Calculate the percentage by dividing each cell by the total counts
per 'SeniorCitizen' row
percentage data = count data.div(count data.sum(axis=1), axis=0) * 100
# Step 2: Plot the stacked bar chart
plt.figure(figsize=(3, 4))
# Plot each section of the stack
bottom = None
for churn_status in percentage_data.columns:
    plt.bar(percentage data.index, percentage data[churn status],
bottom=bottom, label=churn status)
    bottom = percentage data[churn status] if bottom is None else
bottom + percentage data[churn status]
# Adding labels and title
plt.xlabel("SeniorCitizen")
```

```
plt.ylabel("Percentage of Total (%)")
plt.title("Percentage of Churn by SeniorCitizen Status")
plt.legend(title="Churn", bbox_to_anchor=(1.05, 1), loc='upper left')
# Display the plot
plt.show()
```

## Percentage of Churn by SeniorCitizen Status

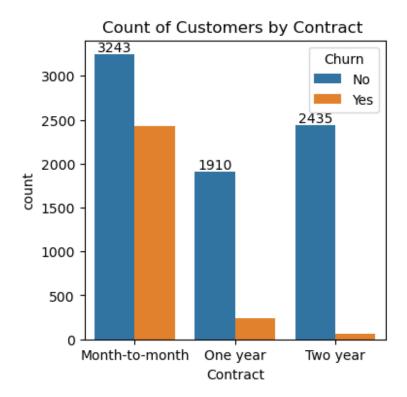


```
plt.figure(figsize = (9, 4))
sns.histplot(x = "tenure", data = df, bins = 72, hue = "Churn")
plt.show()
```

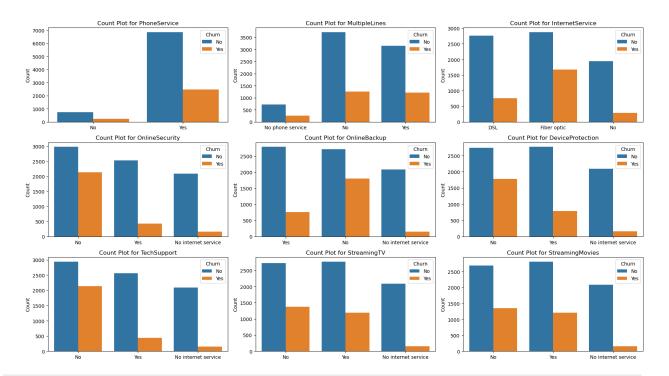


```
# People who have used our services for a long time have statyed and
pople who have used our services # 1 or 2 months have churned

plt.figure(figsize = (4,4))
ax = sns.countplot(x = "Contract", data = df, hue = "Churn")
ax.bar_label(ax.containers[0])
plt.title("Count of Customers by Contract ")
plt.show()
```

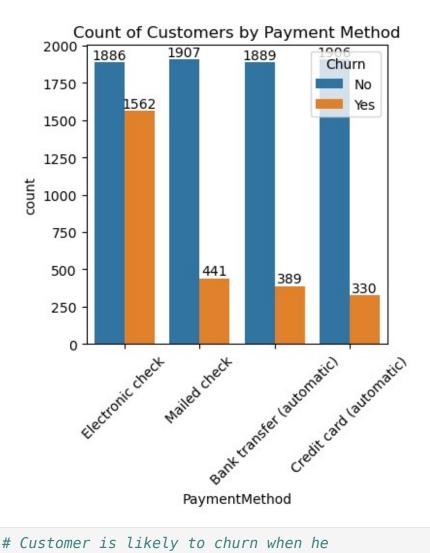


```
# Popole who have month to month contract are likely to churn then
form those who have 1 or 2 years ar contract
df.columns.values
array(['customerID', 'gender', 'SeniorCitizen', 'Partner',
'Dependents',
       'tenure', 'PhoneService', 'MultipleLines', 'InternetService',
       'OnlineSecurity', 'OnlineBackup', 'DeviceProtection',
       'TechSupport', 'StreamingTV', 'StreamingMovies', 'Contract',
       'PaperlessBilling', 'PaymentMethod', 'MonthlyCharges',
       'TotalCharges', 'Churn'], dtype=object)
# Define the list of columns you want to plot
columns = ['PhoneService', 'MultipleLines', 'InternetService',
'OnlineSecurity',
           'OnlineBackup', 'DeviceProtection', 'TechSupport',
'StreamingTV', 'StreamingMovies']
# Calculate the number of rows and columns for subplots grid
n cols = 3 # Number of plots per row
n rows = (len(columns) + n cols - 1) // n cols # Calculate required
number of rows
# Set up the matplotlib figure
fig, axes = plt.subplots(n rows, n cols, figsize=(18, 10))
axes = axes.flatten() # Flatten to easily iterate over
# Create a count plot for each column
for i, column in enumerate(columns):
    sns.countplot(data=df, x=column, ax=axes[i], hue = df["Churn"])
    axes[i].set title(f'Count Plot for {column}')
    axes[i].set xlabel('')
    axes[i].set ylabel('Count')
# Remove any empty subplots if the grid isn't perfectly filled
for j in range(i + 1, len(axes)):
    fig.delaxes(axes[j])
plt.tight layout()
plt.show()
```



# The plots show the distribution of various telecom services among customers, segmented by churn status. Key observations include that most customers have phone service, with a significant portion not opting for multiple lines. Internet services are split, with fiber optic users showing a higher churn rate. Features like online security, backup, device protection, tech support, and streaming services display lower churn for customers who opted out, suggesting that these additional services might influence churn behavior.

```
plt.figure(figsize = (4,4))
ax = sns.countplot(x = "PaymentMethod", data = df, hue = "Churn")
ax.bar_label(ax.containers[0])
ax.bar_label(ax.containers[1])
plt.title("Count of Customers by Payment Method")
plt.xticks(rotation =45)
plt.show()
```



# Customer is likely to churn when he