## Importing:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
%matplotlib inline
import seaborn as sns
import warnings
warnings.filterwarnings('ignore')
pd.set_option('display.max_columns', 500)
```

## Reading the dataset:

```
df = pd.read csv('telecom churn data.csv')
df.head()
   mobile_number circle_id loc_og t2o mou
                                             std og t2o mou
loc ic t2o mou \
      7000842753
                        109
                                        0.0
                                                         0.0
0.0
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      7001865778
                        109
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0.0
2
      7001625959
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3
      7001204172
                        109
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                                                         0.0
4
      7000142493
                        109
0.0
  last date of month 6 last date of month 7 last date of month 8
0
             6/30/2014
                                  7/31/2014
                                                        8/31/2014
                                                        8/31/2014
1
             6/30/2014
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2
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                         arpu 6
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onnet mou 6
0
             9/30/2014
                        197.385 214.816
                                          213.803
                                                    21,100
NaN
             9/30/2014
                         34.047 355.074 268.321
                                                    86.285
1
24.11
                        167.690 189.058 210.226 290.714
             9/30/2014
2
11.54
             9/30/2014
                        221.338 251.102
                                          508.054
                                                   389.500
3
99.91
             9/30/2014
                        261.636 309.876 238.174 163.426
50.31
```

onnet_mou_7 offnet_mou_7 offnet_mou_7 offnet_mou_7 offnet_mou_7 offnet_mou_9         onnet_mou_9 offnet_mou_6           offnet_mou_7 offnet_mou_7 offnet_mou_9 in NaN         0.00         NaN         NaN         NaN           1         78.68         7.68         18.34         15.74         99.84           2         55.24         37.26         74.81         143.33         220.59           3         54.39         310.98         241.71         123.31         109.01           4         149.44         83.89         58.78         76.96         91.88           offnet_mou_8 romu_6         offnet_mou_9 romu_1c_mou_6         roam_ic_mou_7 rou_7         roam_ic_mou_7 rou_7           0         0.00         NaN         NaN         NaN           0.00         3         71.68         113.54         0.0         54.86           44.38         4         124.26         45.81         0.0         0.00           roam_ic_mou_9 roam_og_mou_6         roam_og_mou_7 roam_og_mou_8         roam_og_mou_9 nou_9 nou_7 roam_og_mou_8           roam_og_mou_9 nou_9 nou_							
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roam_ic_mou_8         NaN         NaN         NaN           0.00         0.00         0.00         0.00           1         304.76         53.76         0.0         0.00           0.00         2         208.36         118.91         0.0         0.00           3         71.68         113.54         0.0         54.86           44.38         4         124.26         45.81         0.0         0.00           0.00         NaN         NaN         NaN         0.00           8         roam_og_mou_9         NaN         NaN         NaN         0.00           NaN         NaN         NaN         0.00         0.00         0.00           NaN         NaN         0.00         0.00         0.00         0.00           70.94         3         0.00         0.00         0.00         0.00         0.00           4         0.00         0.0         0.00         0.00         0.00         0.00           0.00         NaN         NaN         NaN         0.00         0.00         0.00           1         23.88         74.56         7.68         18.34         2         7.19         28.74<	4	149.44	83.89	58.78	76.9	6	91.88
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1 0.00 0.00 0.00 0.00 0.00 0.00 2 38.49 0.0 0.00 0.00 70.94 3 0.00 0.0 28.09 39.04 0.00 4 0.00 0.0 0.0 0.00 0.00 0.00  loc_og_t2t_mou_6 loc_og_t2t_mou_7 loc_og_t2t_mou_8 loc_og_t2t_mou_9 \ 0 NaN NaN 0.00 NaN 1 23.88 74.56 7.68 18.34 2 7.19 28.74 13.58 14.39 3 73.68 34.81 10.61	0		NaN		NaN	0.00	
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70.94 3		38.49	0.0		0.00	0.00	
0.00 4					0.00		
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0     NaN     NaN     0.00       NaN     74.56     7.68       18.34     7.19     28.74     13.58       14.39     3     73.68     34.81     10.61			loc_og_t2t_	mou_7 lo	oc_og_t2t_mou	_8	
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2 7.19 28.74 13.58 14.39 3 73.68 34.81 10.61		23.88		74.56	7.	68	
14.39 3 73.68 34.81 10.61		7 10		20 74	10	EO	
3 73.68 34.81 10.61		7.19		20./4	13.	36	
		73.68		34.81	10.	61	

4 58.78	50.31	149.44		83.89
loc_o		loc_og_t2m_mou_7	loc_o	g_t2m_mou_8
0	2m_mou_9 \ NaN	NaN		0.00
NaN 1 53.76	11.51	75.94		291.86
28.16	29.34	16.86		38.46
3 65.46	107.43	83.21		22.46
4 37.89	67.64	91.88		124.26
	g_t2f_mou_6 2f_mou_9 \	loc_og_t2f_mou_7	loc_o	g_t2f_mou_8
0 NaN	NaN	NaN		0.00
1 0.00	0.00	0.00		0.00
2 22.24	24.11	21.79		15.61
3 2.06	1.91	0.65		4.91
4 1.93	0.00	0.00		0.00
	g_t2c_mou_6 2c mou 9 \	loc_og_t2c_mou_7	loc_o	g_t2c_mou_8
0	NaN	NaN		0.00
NaN 1	0.0	2.91		0.00
0.00 2	0.0	135.54		45.76
0.48 3	0.0	0.00		0.00
0.00 4	0.0	0.00		0.00
0.00				
	g_mou_6 loc 2t_mou_6 \	_og_mou_7 loc_og		loc_og_mou_9
0 NaN	NaN	NaN	0.00	NaN
1 0.23	35.39	150.51	299.54	72.11
2 4.34	60.66	67.41	67.66	64.81

3 183.03	118.68	37.99 83.0
26.23 4 117.96 0.00	241.33 2	08.16 98.6
std_og_t2t_mou_7 std_og_t2m_mou_6 \	std_og_t2t_mou_8	std_og_t2t_mou_9
0 NaN NaN	0.00	NaN
1 4.11	0.00	0.00
0.00 2 26.49 41.81	22.58	8.76
3 14.89 2.99	289.58	226.21
4 0.00 9.31	0.00	0.00
std_og_t2m_mou_7 std_og_t2f_mou_6 \	std_og_t2m_mou_8	std_og_t2m_mou_9
0 NaN	0.00	NaN
0.46	0.13	0.00
0.00 2 67.41 1.48	75.53	9.28
3 1.73	6.53	9.99
0.00 4 0.00 0.00	0.00	0.00
std_og_t2f_mou_7 std og t2c mou 6 \	std_og_t2f_mou_8	std_og_t2f_mou_9
0 NaN	0.00	NaN
NaN 1 0.00	0.00	0.0
0.0 2 14.76	22.83	0.0
0.0 3 0.00	0.00	0.0
0.0		
4 0.00 0.0	0.00	0.0
std_og_t2c_mou_7	std_og_t2c_mou_8	std_og_t2c_mou_9
0 NaN	0.0	NaN
1 0.0	0.0	0.0

2	0.0	0.0	0.0	47.64
3	0.0	0.0	0.0	29.23
4	0.0	0.0	0.0	9.31
	std_og_mou_8	std_og_mou_9	isd_og_mou_6	
isd_og_mou_7 \ 0 NaN	0.00	NaN	NaN	
NaN 1 4.58	0.13	0.00	0.0	
0.0 2 108.68 0.0	120.94	18.04	0.0	
3 16.63 0.0	296.11	236.21	0.0	
4 0.00 0.0	0.00	0.00	0.0	
isd_og_mou_8	isd_og_mou_9	spl_og_mou_6	spl_og_mou_7	
spl_og_mou_8 \ 0 0.0 0.00	NaN	NaN	NaN	
1 0.0 12.76	0.0	4.68	23.43	
2 0.0 96.84	0.0	46.56	236.84	
3 0.0 18.09	0.0	10.96	0.00	
4 0.0 0.00	0.0	0.00	0.00	
spl_og_mou_9 0 NaN 1 0.00	og_others_6 NaN 0.00	og_others_7 on NaN 0.0	og_others_8 og 0.0 0.0	_others_9 \ NaN 0.0
2 42.08 3 43.29 4 5.98	0.45 0.00 0.00	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0
total_og_mou 0 0.0 1 40.3 2 155.3 3 223.3 4 127.3	90 6 31 178 33 412 23 135	0.00 3.53 2.94 5.31	_mou_8 total_o 0.00 312.44 285.46 352.21 208.16	g_mou_9 \     0.00 72.11 124.94 362.54 104.59
loc_ic_t2t_moloc_ic_t2t_mou_9		2t_mou_7 loc_: NaN	ic_t2t_mou_8 0.16	

NaN		_		
1 116.09	1.61	29.	91	29.23
2	115.69	71.	11	67.46
148.23	62.00	10	00	0.04
3 41.73	62.08	19.	98	8.04
4	105.68	88.	49	233.81
154.56				
		loc_ic_t2m_mou	_7 loc_i	c_t2m_mou_8
loc_ic_t 0	2m_mou_9 \ NaN	N	aN	4.13
NaN	Ivaiv	IV	aiv	4.13
1	17.48	65.	38	375.58
56.93 2	14.38	15.	44	38.89
38.98				
3 52.86	113.96	64.	51	20.28
4	106.84	109.	54	104.13
48.24				
loc i	c t2f mou 6	loc ic t2f mou	7 loc i	c t2f mou 8
loc_ic_t	2f_mou_9 \			
0 NaN	NaN	N	aN	1.15
1	0.00	8.	93	3.61
0.00	00.40	100	20	40.60
2 158.19	99.48	122.	29	49.63
3	57.43	27.	09	19.84
65.59	1 50	0	00	0.00
4 0.00	1.50	0.	00	0.00
				1
	c_mou_6 loc_ 2t mou 6 \	_ic_mou_7 loc_	1c_mou_8	toc_1c_mou_9
0	NaN (	NaN	5.44	NaN
NaN 1	19.09	104.23	408.43	173.03
0.00	19.09	104.23	400.43	1/3.03
2	229.56	208.86	155.99	345.41
72.41 3	233.48	111.59	48.18	160.19
43.48				
4	214.03	198.04	337.94	202.81
0.00				
std_i	c_t2t_mou_7	std_ic_t2t_mou	_8 std_i	c_t2t_mou_9

	_t2m_mou_6 \	0.00	NoN	
0 NaN	NaN	0.00	NaN	
1	0.00	2.35	0.00	
5.90				
2 45 10	71.29	28.69	49.44	
45.18 3	66.44	0.00	129.84	
1.33	00111	0100	123101	
4	0.00	0.86	2.31	
1.93				
	_ic_t2m_mou_7 _t2f_mou_6 \	std_ic_t2m_mou_8	std_ic_t2m_mou_9	
0	NaN	0.00	NaN	
NaN				
1	0.00	12.49	15.01	
0.00 2	177.01	167.09	118.18	
21.73	177.01	107.03	110.10	
3	38.56	4.94	13.98	
1.18	0.25	0.00	0.00	
4 0.00	0.25	0.00	0.00	
0.00				
		std_ic_t2f_mou_8	std_ic_t2f_mou_9	
std_ic	_ic_t2f_mou_7 _t2o_mou_6 \ NaN	std_ic_t2f_mou_8 0.00	std_ic_t2f_mou_9 NaN	
std_ic 0 NaN	_t2o_mou_6 \ NaN	0.00	naN	
std_ic 0 NaN 1	_t2o_mou_6 \			
std_ic 0 NaN	_t2o_mou_6 \ NaN	0.00	naN	
std_ic 0 NaN 1 0.0 2	_t2o_mou_6 \ NaN 0.00 58.34	0.00 0.00 43.23	NaN 0.00 3.86	
std_ic 0 NaN 1 0.0 2 0.0 3	_t2o_mou_6 \ NaN 0.00	0.00	NaN 0.00	
std_ic 0 NaN 1 0.0 2 0.0 3	_t2o_mou_6 \	0.00 0.00 43.23 0.00	NaN 0.00 3.86 0.00	
std_ic 0 NaN 1 0.0 2 0.0 3	_t2o_mou_6 \ NaN 0.00 58.34	0.00 0.00 43.23	NaN 0.00 3.86	
std_ic 0 NaN 1 0.0 2 0.0 3 0.0 4 0.0	t2o_mou_6 \	0.00 0.00 43.23 0.00 0.00	NaN 0.00 3.86 0.00 0.00	
std_ic 0 NaN 1 0.0 2 0.0 3 0.0 4 0.0	t2o_mou_6 \	0.00 0.00 43.23 0.00	NaN 0.00 3.86 0.00 0.00	std_ic_mou_6
std_ic 0 NaN 1 0.0 2 0.0 3 0.0 4 0.0	t2o_mou_6 \	0.00 0.00 43.23 0.00 0.00	NaN 0.00 3.86 0.00 0.00	std_ic_mou_6 NaN
std_ic 0 NaN 1 0.0 2 0.0 3 0.0 4 0.0	_t2o_mou_6 \	0.00 0.00 43.23 0.00 0.00 std_ic_t2o_mou_8 0.0	NaN 0.00 3.86 0.00 0.00 std_ic_t2o_mou_9	NaN
std_ic 0 NaN 1 0.0 2 0.0 3 0.0 4 0.0 std	_t2o_mou_6 \	0.00 0.00 43.23 0.00 0.00 std_ic_t2o_mou_8	NaN 0.00 3.86 0.00 0.00 std_ic_t2o_mou_9 NaN	
std_ic 0 NaN 1 0.0 2 0.0 3 0.0 4 0.0 std	_t2o_mou_6 \	0.00 0.00 43.23 0.00 0.00 std_ic_t2o_mou_8 0.0 0.0	NaN 0.00 3.86 0.00 0.00 std_ic_t2o_mou_9 NaN 0.0 0.00	NaN 5.90 139.33
std_ic 0 NaN 1 0.0 2 0.0 3 0.0 4 0.0 std \ 0	_t2o_mou_6 \	0.00 0.00 43.23 0.00 0.00 std_ic_t2o_mou_8 0.0 0.0 0.0	NaN 0.00 3.86 0.00 0.00 std_ic_t2o_mou_9 NaN 0.0 0.00 0.00	NaN 5.90 139.33 45.99
std_ic 0 NaN 1 0.0 2 0.0 3 0.0 4 0.0 std	_t2o_mou_6 \	0.00 0.00 43.23 0.00 0.00 std_ic_t2o_mou_8 0.0 0.0	NaN 0.00 3.86 0.00 0.00 std_ic_t2o_mou_9 NaN 0.0 0.00	NaN 5.90 139.33

std_i	ic_mou_7 st	d_ic_mou_8 std	_ic_mou_9 tot	al_ic_mou_6
	mou7 \	0.00	N - N	0.00
0 0.00	NaN	0.00	NaN	0.00
1	0.00	14.84	15.01	26.83
104.23		222 22		270.04
2 519.53	306.66	239.03	171.49	370.04
3	105.01	4.94	143.83	280.08
216.61				
4	0.25	0.86	2.31	216.44
198.29				
		total_ic_mou_9	spl_ic_mou_6	spl_ic_mou_7
	nou_8 \ 5.44	0.00	NaN	NaN
0 0.0	5.44	0.00	INdiv	NaN
1	423.28	188.04	0.00	0.0
0.0	205 02	F17 74	0.21	0.0
2 0.0	395.03	517.74	0.21	0.0
3	53.13	305.38	0.59	0.0
0.0	222.24			
4 0.0	338.81	205.31	0.00	0.0
0.0				
		sd_ic_mou_6 isd	_ic_mou_7 isd	_ic_mou_8
isd_ic_m 0	nou_9 \ NaN	NaN	NaN	0.0
NaN	Nan	Nan	Nan	0.0
1	0.00	1.83	0.00	0.0
0.00 2	0.45	0.00	0.85	0.0
0.01	0.45	0.00	0.05	0.0
3	0.55	0.00	0.00	0.0
0.00 4	0.18	0.00	0.00	0.0
0.00	0.10	0.00	0.00	0.0
				_
_		_others_7 ic_ot	hers_8 ic_oth	ers_9
0	ech_num_6 \ NaN	NaN	0.0	NaN
4				
1	0.00	0.00	0.0	0.00
4 2	0.93	3.14	0.0	0.36
5				
	0.00	0.00	0.0	0.80
10				

4	0.48	0.00	0.0	0.00	
5					
	<pre>cal_rech_num_7 rech amt 6 \</pre>	total_rech_num	_8 total_	_rech_num_9	
0	3		2	6	
362 1	9		11	5	
74	4		2	7	
2 168	4		2	/	
3 230	11		18	14	
4	6		3	4	
196					
	al_rech_amt_7	total_rech_amt	_8 total	_rech_amt_9	
max_re	ech_amt_6 \ 252	2	52	0	
252					
1 44	384	2	83	121	
2	315	1	16	358	
86 3	310	6	01	410	
60					
4 56	350	2	87	200	
max	<pre>c_rech_amt_7 ma</pre>	ax_recn_amt_8	max_recn_a	amt_9 date_o1	_last_rech_6
Θ	252	252		0	6/21/2014
1	154	65		50	6/29/2014
2	200	86		100	6/17/2014
3	50	50		50	6/28/2014
4	110	110		50	6/26/2014
date 0 1 2 3	e_of_last_rech_7 7/16/2014 7/31/2014 7/24/2014 7/31/2014 7/28/2014	8/ 8/2 8/1 8/3	rech_8 dat 8/2014 8/2014 4/2014 1/2014 9/2014	te_of_last_re 9/28/ 9/30/ 9/29/ 9/30/ 9/28/	/2014 /2014 /2014 /2014
las	st_day_rch_amt_6	i last_day_rch	_amt_7 la	ast_day_rch_a	amt_8 \

			0-0	
0 1 2	252 44 0	252 23 200	252 30 86	
3 4	30 50	50 110	50 110	
<pre>last_day_ date_of_last_</pre>		_of_last_rech_data_6 \		
0 7/16/2014	0 -	6/21/2014		
1	0	NaN		
7/25/2014 2 NaN	0	NaN		
3	30	NaN		
NaN 4	50	6/4/2014		
NaN				
	st_rech_data_8	date_of_last_rech_da	ta_9 total_rec	h_data_6
0	8/8/2014		NaN	1.0
1	8/10/2014		NaN	NaN
2	NaN	9/17/	2014	NaN
3	NaN		NaN	NaN
4	NaN		NaN	1.0
max_rech_data		l_rech_data_8 total_	_recn_data_9	
0 252.0	1.0	1.0	NaN	
1	1.0	2.0	NaN	
NaN 2	NaN	NaN	1.0	
NaN 3	NaN	NaN	NaN	
NaN				
4 56.0	NaN	NaN	NaN	
	data 7 max re	ch_data_8 max_rech_d	lata_9 count_re	ch 2g 6
0	252.0	252.0	NaN	0.0
1	154.0	25.0	NaN	NaN

2	NaN	NaN		46.0	Nal	N
3	NaN	NaN		NaN	Nal	N
4	NaN	NaN		NaN	1.0	9
coun	t_rech_2g_7 (	count_rech_2g_8	count	_rech_2g_9	count_rech_3g_0	δ
ò	0.0	0.0		NaN	1.0	0
1	1.0	2.0		NaN	Nal	N
2	NaN	NaN		1.0	Nal	N
3	NaN	NaN		NaN	Naf	N
4	NaN	NaN		NaN	0.0	0
		count_rech_3g_8	count	_rech_3g_9		
av_rech 0	_amt_data_6 \ 1.0	1.0		NaN		
252.0	110	110		Hait		
1	0.0	0.0		NaN		
NaN						
2	NaN	NaN		0.0		
NaN 3	NaN	NaN		NaM		
s NaN	NaN	NaN		NaN		
4	NaN	NaN		NaN		
56.0	Ivaiv	IValv		INdiv		
	ech_amt_data_7 mb_6 \	<pre>7 av_rech_amt_</pre>	data_8	av_rech_amt	_data_9	
0	252.6	)	252.0		NaN	
30.13						
1	154.0	)	50.0		NaN	
0.00						
2	NaN	l	NaN		46.0	
0.00						
3	Nan	l	NaN		NaN	
0.00 4	NaN	ı	NaN		NaN	
0.00	ivai	V	Ivaiv		IVAIV	
-	2 7 3 3	)		1 2		
		2g_mb_8		vol_3g_mb_6	vol_3g_mb_7 \	/
0 1	1.32 108.07	5.75 365.47	0.0 $0.0$	83.57 0.00	150.76 0.00	
2	0.00	0.00	0.0	0.00	0.00	
_	0100	0100	0.0	0.00	0.00	

3	0.00 0.00	0.00 0.00		0.0 0.0	0.00 0.00	0.00 0.00
2 5	vol_3g_mb_8	vol_3g_mb_9	arpu_3g_	_6 arpu_	3g_7 arpu_3	8g_8
0	pu_3g_9 \ 109.61	0.00	212.3	17 21	2.17 212	2.17
Nal		0.00	2121.	L, 21	2.17 212	17
1	0.00	0.00	) Na	aN	0.00	0.00
Nal						
2 2.8	0.00	8.42	! Na	aN	NaN	NaN
3	0.00	0.00	) Na	aN	NaN	NaN
Nal		0.00	IVO	aiv	IVAIV	IVAIN
4	0.00	0.00	0.0	90	NaN	NaN
Nal	V					
	2		2 . 0		a Carloto a a Lo	
0	arpu_2g_6 a 212.17	rpu_2g_/ ar 212.17	`pu_2g_8 a 212.17	arpu_2g_9 NaN	night_pck_	_user_6 \ 0.0
1	NaN	28.61	7.60	NaN		NaN
2	NaN	NaN	NaN	0.0		NaN
3 4	NaN	NaN	NaN	NaN		NaN
4	0.00	NaN	NaN	NaN		0.0
	night nek us	or 7 night	nck uson (	night	nck uson 0	man+hlv 2a 6
\	night_pck_us	er_/ Hight_	pck_user_c	o litgiit_	pck_user_9	monthty_2g_0
ò		0.0	0.0	9	NaN	Θ
1		0.0	0.0	9	NaN	0
2		NaN	Nal	ı	0.0	0
_		IVAIV	IVai	V	0.0	U
3		NaN	Nal	J	NaN	0
4		NI – NI	NI - N		NI – NI	0
4		NaN	Nal	V	NaN	Θ
	monthly_2g_7	monthly_2g	_8 month	Ly_2g_9	sachet_2g_6	sachet_2g_7
\						
0	0		0	0	0	0
1	1		0	0	0	0
-	_		Ū	· ·	Ŭ	O
2	0		Θ	0	0	0
2	0		0	0	0	0
3	0		0	0	0	0
4	0		0	0	1	0
				-	_	
	b-+ 2: 0			2- 6		
\	sacnet_2g_8	sacnet_2g_9	monthly_	_3g_o mo	nthly_3g_/	monthly_3g_8
/						

0	Θ	)	0		1		1		1
1	2	2	0		0		0		0
2	0	)	1		0		0		0
3	0		0		0		0		0
4	0	)	0		0		0		0
0 1 2 3 4		9 sachet_ 0 0 0 0 0	_3g_6 0 0 0 0	sachet_3g	9_7 s 0 0 0 0 0		8 sach 0 0 0 0 0	et_3g_9 6 6 6 6	
	fb_user_6 _vbc_3g \	fb_user_7 1.0 1.0 NaN NaN NaN	fb_us	er_8 fb_ 1.0 1.0 NaN NaN NaN	user_ Na Na 1. Na	aN 968 aN 1006 .0 1103 aN 2491		_3g 0.4 0.0 0.0 0.0 0.0	
0 1 2 3 4	jun_vbc_3g 101.20 0.00 4.17 0.00 0.00	sep_vbc_3 3.5 0.6 0.6 0.6	58 00 00 00						

Handling the missing values:

```
74.85
arpu 2q 6
max rech data 6
                      74.85
                        . . .
                       0.00
max rech amt 7
max rech amt 6
                       0.00
                       0.00
total rech amt 9
total_rech_amt 8
                       0.00
sep_vbc 3g
                       0.00
[226 rows x 1 columns]
# List the columns having more than 30% missing values
col list missing 30 =
list(df missing columns.index[df missing columns['null'] > 30])
# Delete the columns having more than 30% missing values
df = df.drop(col list missing 30, axis=1)
df.shape
(99999, 186)
#Deleting the date columns as the date columns are not required in our
analysis
# List the date columns
date cols = [k for k in df.columns.to list() if 'date' in k]
print(date cols)
# Dropping date columns
df = df.drop(date cols, axis=1)
['last_date_of_month_6', 'last_date_of_month_7',
'last_date_of_month_8', 'last_date_of_month_9', 'date_of_last_rech_6',
'date_of_last_rech_7', 'date_of_last_rech_8', 'date_of_last_rech_9']
# Drop circle id column
df = df.drop('circle id', axis=1)
df.shape
(99999, 177)
```

Filter high-value customers:

```
df['avg_rech_amt_6_7'] = (df['total_rech_amt_6'] +
df['total_rech_amt_7'])/2

X = df['avg_rech_amt_6_7'].quantile(0.7)
X
368.5
```

<pre>df = df[ df.head(</pre>		g_rech_am	t_6_7'] >:	= X]		
	le_num \	ber loc_	og_t2o_mo	u std_og_t2o	_mou loc_ic_	_t2o_mou
7 7	000701	601	0.0	9	0.0	0.0
	001524	846	0.0	9	0.0	0.0
_	002191	713	0.0	9	0.0	0.0
492.846 16 7	000875	565	0.0	9	0.0	0.0
430.975 17 7 690.008	000187	447	0.0	9	0.0	0.0
	pu_7	arpu_8	arpu_9	onnet_mou_6	onnet_mou_7	onnet_mou_8
7 1349	.850	3171.480	500.000	57.84	54.68	52.29
8 492	.223	137.362	166.787	413.69	351.03	35.08
13 205	.671	593.260	322.732	501.76	108.39	534.24
16 299	.869	187.894	206.490	50.51	74.01	70.61
17 18	.980	25.499	257.583	1185.91	9.28	7.79
	<b>4</b>	0		££ 7	-fft 0	
offnet_m		\		ffnet_mou_7		
7 NaN	Na	N	453.43	567.16	325.91	
8	33.4	6	94.66	80.63	136.48	
108.71 13	244.8	1	413.31	119.28	482.46	
214.06 16	31.3	1	296.29	229.74	162.76	
224.39	21.5	+				
17 87.89	558.5	1	61.64	0.00	5.54	
		6			. 0	
roam_og_	_ic_mo mou_6	_	_1c_mou_/	roam_ic_mou	_8 roam_ic_r	nou_9
7 23.74	_ 16	.23	33.49	31.	64	NaN
8	0	.00	0.00	0.	00	0.00
0.00 13	22	.53	144.24	72.	11 13	36.78
7.98	23	.55	177124	72.	1.	,0.70

16	0.00	2.83	0.00		0.00
0.00					
17	0.00	4.76	4.81		0.00
0.00					
			_og_mou_9	loc_og_t2	
7	12.59	38.06	NaN		51.39
8 13	0.00 35.26	0.00 1.44	0.00 12.78		297.13 49.63
16	17.74	0.00	0.00		42.61
17	8.46	13.34	17.98		38.99
_,	01.10	25.5.	27.50		30.33
loc_og_ loc_og_t2m		loc_og_t2t_mou_8	loc_og_t	2t_mou_9	
7	31.38	40.28		NaN	
308.63					
8	217.59	12.49		26.13	
80.96					
13	6.19	36.01		6.14	
151.13					
16	65.16	67.38		26.88	
273.29	0.00	0.00		26 41	
17	0.00	0.00		36.41	
58.54					
loc og	t2m mou 7	loc og t2m mou 8	loc og t	2m mou 9	
loc og t2f			100_09_1		
7	447.38	162.28		NaN	
62.13					
8	70.58	50.54		34.58	
0.00	47.00	204 46		100 24	
13	47.28	294.46		108.24	
4.54 16	145.99	128.28		201.49	
0.00	145.99	120.20		201.49	
17	0.00	0.00		9.38	
0.00	0100	0100		3.30	
		loc_og_t2f_mou_8	loc_og_t	2f_mou_9	
loc_og_t2c_	_				
7	55.14	53.23		NaN	
0.0	0.00	2 22		0.00	
8	0.00	0.00		0.00	
0.0 13	0.00	22 51		F 20	
0.0	0.00	23.51		5.29	
16	4.48	10.26		4.66	
0.0	7.70	10.20		7.00	
17	0.00	0.00		0.00	
0.0	-				
0.0					

	oc_og_t2c_mou_7	loc_og_t2c_mou_8	loc_og_t2c_mou_9	loc_og_mou_6
\ 7	0.0	0.00	NaN	422.16
8	0.0	7.15	0.0	378.09
13	0.0	0.49	0.0	205.31
16	0.0	0.00	0.0	315.91
17	0.0	0.00	0.0	97.54
7 8 13 16 17	oc_og_mou_7 loc 533.91 288.18 53.48 215.64 0.00	255.79 63.04 353.99 1 205.93 2	NaN 60.71 1 19.69 4 33.04	mou_6 \ 4.30 16.56 46.41 7.89 46.91
		std_og_t2t_mou_8	std_og_t2t_mou_9	
7	g_t2m_mou_6 \ 23.29	12.01	NaN	
49.89 8	133.43	22.58	7.33	
13.69 13	85.98	498.23	230.38	
255.30 16		3.23	4.46	
22.99				
17 1.55	0.81	0.00	504.11	
		std_og_t2m_mou_8	std_og_t2m_mou_9	
7	g_t2f_mou_6 \ 31.76	49.14	NaN	
6.66 8	10.04	75.69	74.13	
0.00 13	52.94	156.94	96.01	
0.00 16	64.51	18.29	13.79	
0.00				
17 0.00	0.00	0.00	78.51	
S	td_og_t2f_mou_7	std_og_t2f_mou_8	std_og_t2f_mou_9	
std_og 7	g_t2c_mou_6 \ 20.08	16.68	NaN	
	_0.00			

0.0					
8	0	.00	0.00	0.00	
0.0					
13	0	.00	0.00	0.00	
0.0		0.0	0.00	4 42	
16	Θ	.00	0.00	4.43	
0.0 17	A	.00	0.00	0.00	
0.0	U	.00	0.00	0.00	
0.0					
std_d	og_t2c_mo	u_7 std_og_t2	c_mou_8 std_	og_t2c_mou_9	std_og_mou_6
\	_				
7		0.0	0.0	NaN	60.86
0		0 0	0 0	0.0	120.26
8		0.0	0.0	0.0	130.26
13		0.0	0.0	0.0	701.78
13		0.10	0.0	0.10	701170
16		0.0	0.0	0.0	30.89
			0.0	0.0	1140 46
17		0.0	0.0	0.0	1148.46
std o	og mou 7	std_og_mou_8	std og mou 9	isd og mou 0	5
isd_og_mo		_ 3	_ 3	_ 3	
7	<sup>-</sup> 75.14	77.84	NaN	0.0	9
0.18				_	
8	143.48	98.28	81.46	0.0	9
0.00 13	120 02	6EE 10	226 20	0 (	2
0.00	138.93	655.18	326.39	0.0	9
16	67.09	21.53	22.69	0.0	9
0.00	07.00	22.33	22.00	01.	
17	0.81	0.00	582.63	0.0	9
0.00					
	0		1 0	-	-
spl_og_ma	og_mou_8	isd_og_mou_9	spr_og_mou_6	spt_og_mou_	/
5pt_0g_iiit 7	10.01	NaN	4.50	0.00	)
6.50	10.01	Naiv	7.50	0.00	,
8	0.00	0.0	0.00	0.00	)
10.23					
13	1.29	0.0	0.00	0.00	9
4.78					
16	0.00	0.0	0.00	3.26	)
5.91 17	0.00	0.0	2.58	0.00	)
0.00	0.00	0.0	2.30	0.00	,
3.00					
spl	og_mou_9	og_others_6	og_others_7	og_others_8	
_					

og_others_9		0.00	0 0	0.0	NoN
7	NaN	0.00	0.0	0.0	NaN
8	0.00	0.00	0.0	0.0	0.0
13	0.00	0.00	0.0	0.0	0.0
16	0.00	0.00	0.0	0.0	0.0
17	2.64	0.93	0.0	0.0	0.0
7	487.53	otal_og_mou_7 609.24	350	.16	og_mou_9 \ 0.00
8 13	508.36 907.09	431.66 192.41	171 1015		142.18 446.09
16	346.81	286.01	233	.38	255.74
17	1249.53	0.81	Θ	.00	631.08
		loc_ic_t2t_mou	_7 loc_ic_	t2t_mou_8	
loc_ic_t2t_ 7	_mou_9 \ 58.14	32.	26	27.31	
NaN					
8 4.03	23.84	9.	84	0.31	
13	67.88	7.	58	52.58	
24.98	41 22	71	4.4	20.00	
16 50.23	41.33	71.	44	28.89	
17	34.54	0.	00	0.00	
40.91					
	_t2m_mou_6	loc_ic_t2m_mou	_7 loc_ic_	t2m_mou_8	
loc_ic_t2m_ 7	_mou_9 \ 217.56	221.	49	121.19	
NaN					
8 17.34	57.58	13.	98	15.48	
13	142.88	18.	53	195.18	
104.79 16	226.81	149.	60	150.16	
172.86	220.01	149.	09	130.10	
17	47.41	2.	31	0.00	
43.86					
	_t2f_mou_6	loc_ic_t2f_mou	_7 loc_ic_	t2f_mou_8	
loc_ic_t2f_ 7	_mou_9 \ 152.16	101.	46	39.53	
NaN					
8	0.00	0.	00	0.00	

0.00				
13	4.81		0.00	7.49
8.51	0.71		0.60	22 71
16 65.21	8.71		8.68	32.71
17	0.00		0.00	0.00
0.71	0.00		0.00	0100
		_ic_mou_7 l	oc_ic_mou	_8 loc_ic_mou_9
5t0_1c_t2 7	t_mou_6 \ 427.88	355.23	188.	04 NaN
36.89	427.00	333.23	100.	04 Nan
8	81.43	23.83	15.	79 21.38
0.00				
13	215.58	26.11	255.	26 138.29
115.68 16	276.86	229.83	211	70 200 21
68.79	270.00	229.03	211.	78 288.31
17	81.96	2.31	0.	00 85.49
8.63				
-1.1.1		-1-1-1-1-1-1		d ' - 121 0
	m_mou_6 \	Std_1C_t2t_	mou_8 st	d_ic_t2t_mou_9
7	11.83		30.39	NaN
91.44				
8	0.58		0.10	0.00
22.43	20.20	1	F 4 F 0	62, 20
13 308.13	38.29	1.	54.58	62.39
16	78.64		6.33	16.66
18.68	70.0.			
17	0.00		0.00	0.00
1.28				
std i	c +2m mou 7	std ic t2m	mou 8 st	d_ic_t2m_mou_9
	f mou 6 \	3 td_1tt2	ou_0 50	u_1c_czou_5
7 – –	$\frac{1}{126.99}$	1	41.33	NaN
52.19	4 00		0.65	10.50
8 0.00	4.08		0.65	13.53
13	29.79	3	17.91	151.51
0.00	23173	J	_,,,,_	131.31
16	73.08		73.93	29.58
0.51	0.00		0.00	1 60
17 0.00	0.00		0.00	1.63
0.00				
std_i	.c_t2f_mou_7	std_ic_t2f_	mou_8 st	d_ic_t2f_mou_9
std_ic_t2	o_mou_6 \			_
7	34.24		22.21	NaN

0.0					
8 0.0	0.00	0.0	90	0.0	
13	0.00	1.9	91	0.0	
0.0 16	0.00	2.1	18	0.0	
0.0					
17 0.0	0.00	0.0	90	0.0	
	ic +20 may 7	std is the mou	0 c+d ic +0	o mou 0 - c+	d ic mou 6
\	IC_tzo_iiiou_7	std_ic_t2o_mou_	_o Stu_IC_t2	0_1110u_9 St	u_tc_iiiou_6
7	0.0	Θ.	. 0	NaN	180.54
8	0.0	0	. 0	0.0	22.43
13	0.0	0	. 0	0.0	423.81
16	0.0	Θ	. 0	0.0	87.99
17	0.0	Θ,	. 0	0.0	9.91
total_ic_7 558.04 8 28.49 13 172.58 16 381.56 17 2.31	_mou_7 \     173.08      4.66      68.09  151.73      0.00  L_ic_mou_8 to	ic_mou_8 std_s  193.94  0.75  474.41  82.44  0.00  tal_ic_mou_9  0.00  34.91  631.86  334.56  87.13	NaN 13.53 213.91 46.24 1.63	626.46 103.86 968.61 364.86 91.88 spl_ic_mou	
	ic mou 0 icd	ic mou 6 icd :	ic mou 7 icd	ic mou 0	
Spt	rc_1110n_9	ic_mou_6 isd_:	tc_iiiou_/ 150	_tc_iiiou_o	

isd_ic_mc				
7	NaN	2.06	14.5	53 31.59
NaN	0 0	0.00	0 (	0.00
8	0.0	0.00	0.0	90 0.00
0.00	0 0	245 20	60.	11 202 20
13	0.0	245.28	62.3	11 393.3
259.33	0 0	0.00	0 (	20 0 20
16	0.0	0.00	0.0	90 0.2
0.00	0 0	0.00	0 (	20 0 0
17	0.0	0.00	0.0	90 0.0
0.00				
	-l C -i	+ h 7	- <del>-  </del>	O
	hers_6 ic_o	thers_/ ic_	_others_8	ic_others_9
	ch_num_6 \	15 10	15 14	N = N
7	15.74	15.19	15.14	NaN
5 8	0.00	0.00	0 00	0.00
8	0.00	0.00	0.00	0.00
19	00.40	16.04	21 44	20.21
13	83.48	16.24	21.44	20.31
6		0.00	0.00	2 22
16	0.00	0.00	0.00	0.00
10		0.00	0.00	2 22
17	0.00	0.00	0.00	0.00
19				
+0+01	roch num 7	+a+al rach	num 0 tot	tal rach num O
		totat_recn_	_nulli_8 to	tal_rech_num_9
total_red 7			7	3
	5		/	3
1580	21		1.4	15
8 437	21		14	15
43 <i>7</i> 13	4		11	7
	4		11	1
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16 570	0		2	1
17	2		4	10
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010				
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max rech		cocac_reen_		cac_reen_ame_s
7	790		3638	0
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8	601		120	186
90	001		120	100
13	253		717	353
110	233		, 1,	223
16	348		160	220
110	240		100	220
17	0		30	335
110	U		30	555
110				

	max_rech_amt_	7 max rech	amt 8	max rec	h amt 9	last	day rch ami	t 6
\ 7		_/	1580	max_rec	0	cast_	day_ren_am	0
8		54	30		36			50
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16	11	10	130		220			100
17		0	30		130			30
wal.	last_day_rch_	_amt_7 last_	_day_rc	h_amt_8	last_da	y_rch_	amt_9	
7 -	_2g_mb_6 \	0		779			0	
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17 0.0		0		0			0	
7 8 13	vol_2g_mb_7 0.0 356.0 0.0	vol_2g_mb_8 0.00 0.03 0.02	vol_2	g_mb_9 0.0 0.0 0.0		b_6 v 0.0 0.0 0.0	ol_3g_mb_7 0.00 750.95 0.00	\
16 17	0.0 0.0	0.00 0.00		0.0 0.0		0.0 0.0	0.00 0.00	
\	vol_3g_mb_8	vol_3g_mb_9	month	ly_2g_6	monthly	_2g_7	monthly_2	<b>3_</b> 8
7	0.00	0.0		0		0		0
8	11.94	0.0		Θ		1		0
13	0.00	0.0		0		0		0
16	0.00	0.0		0		0		0
17	0.00	0.0		0		0		0
	monthly_2g_9	sachet_2g_6	sach	et_2g_7	sachet_	2g_8		
saci 7	het_2g_9 \ 0	(	)	0		0	(	9

	•	•	•		
8	0	0	1	3	0
13	0	0	0	3	0
16	0	0	0	0	0
17	0	0	0	0	0
month sachet_3g_ 7		hly_3g_7 mon 0	thly_3g_8 mont 0	:hly_3g_9 0	
	Ü	Ü	Ü	· ·	
0 8	0	0	0	0	
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17	0	0	0	Θ	
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sache jul_vbc_3	t_3g_7 sache g \ 0	t_3g_8 sache <sup>.</sup> 0	t_3g_9 aon a 0 802	nug_vbc_3g 57.74	
19.38	0	2	0 215	21 02	
8 910.65	0	0	0 315	21.03	
13	0	0	0 2607	0.00	
0.00 16	0	Θ	0 511	0.00	
2.45					
17	0	0	0 667	0.00	
0.00					
8 12 13	oc_3g sep_vb 18.74 22.16 0.00 21.89 0.00	c_3g avg_rec 0.0 0.0 0.0 0.0 0.0	h_amt_6_7 1185.0 519.0 380.0 459.0 408.0		
df.shape					
(30011, 1	78)				

Handling missing values in rows:

```
# Count the rows having more than 50% missing values
df_missing_rows_50 = df[(df.isnull().sum(axis=1)) >
```

```
(len(df.columns)//2)1
df missing rows 50.shape
(114, 178)
# Deleting the rows having more than 50% missing values
df = df.drop(df missing rows 50.index)
df.shape
(29897, 178)
# Checking the missing values in columns again
df missing columns =
(round(((df.isnull().sum()/len(df.index))*100),2).to frame('null')).so
rt values('null', ascending=False)
df missing columns
                        null
loc ic mou 9
                        5.32
og others 9
                        5.32
loc og t2t mou 9
                        5.32
loc_ic_t2t_mou 9
                        5.32
loc_og_t2m_mou_9
                        5.32
. . .
                         . . .
max rech amt 7
                        0.00
max rech amt 8
                        0.00
max rech amt 9
                        0.00
last day rch amt 6
                        0.00
avg rech amt 6 7
                        0.00
[178 rows x 1 columns]
# Listing the columns of MOU Sep(9)
print(((df missing columns[df missing columns['null'] ==
5.32]).index).to list())
['loc ic mou 9', 'og others 9', 'loc og t2t mou 9',
'loc_ic_t2t_mou_9', 'loc_og_t2m_mou_9', 'loc_og_t2f_mou_9',
'loc_og_t2c_mou_9', 'std_ic_t2m_mou_9', 'loc_og_mou_9',
'std_og_t2t_mou_9', 'roam_og_mou_9', 'std_ic_t2o_mou_9',
'std_og_t2m_mou_9',
                       'std_og_t2f_mou_9', 'spl_og_mou_9',
'std_og_t2c_mou_9', 'std_og_mou_9', 'isd_og_mou_9',
'std_ic_t2t_mou_9', 'std_ic_mou_9', 'onnet_mou_9', 'spl_ic_mou_9',
'ic_others_9', 'isd_ic_mou_9', 'loc_ic_t2f_mou_9', 'offnet_mou_9',
'loc ic t2m mou 9', 'std ic t2f mou 9', 'roam ic mou 9']
# Creating a dataframe with the condition, in which MOU for Sep(9) are
null
df_null_mou_9 = df[(df['loc_og_t2m_mou_9'].isnull()) &
(df['loc_ic_t2f_mou_9'].isnull()) & (df['roam_og_mou_9'].isnull()) &
(df['std ic t2m mou 9'].isnull()) &
```

```
(df['loc og t2t mou 9'].isnull()) &
(df['std ic t2t mou 9'].isnull()) & (df['loc og t2f mou 9'].isnull())
& (df['loc ic mou 9'].isnull()) &
  (df['loc og t2c mou 9'].isnull()) & (df['loc og mou 9'].isnull()) &
(df['std og t2t mou 9'].isnull()) & (df['roam ic mou 9'].isnull()) &
  (df['loc_ic_t2m_mou_9'].isnull()) &
(df['std\ og\ t2m\ mou\ 9'].isnull())\ \&\ (df['loc\ ic\ t2t\ mou\ 9'].isnull())
& (df['std og t2f mou 9'].isnull()) &
  (df['std og t2c mou 9'].isnull()) & (df['og others 9'].isnull()) &
(df['std og mou 9'].isnull()) & (df['spl_og_mou_9'].isnull()) &
  (df['std\ ic\ t2f\ mou\ 9'].isnull()) \& (df['isd\ og\ mou\ 9'].isnull()) &
(df['std ic mou 9'].isnull()) & (df['offnet mou 9'].isnull()) &
  (df['isd ic mou 9'].isnull()) & (df['ic others 9'].isnull()) &
(df['std_ic_t2o_mou_9'].isnull()) & (df['onnet mou 9'].isnull()) &
  (df['spl ic mou 9'].isnull())]
df null mou 9.head()
     mobile number loc og t2o mou std og t2o mou loc ic t2o mou
arpu 6
        7000701601
                                0.0
                                                 0.0
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1069.180
                                0.0
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97
        7000589828
                                                 0.0
374.863
111
        7001300706
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                                                 0.0
                                                                  0.0
596.301
                                0.0
                                                 0.0
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143
        7000106299
695,609
                                0.0
                                                 0.0
                                                                  0.0
188
        7000340381
734.641
                          arpu 9 onnet mou 6
                                                onnet mou 7
                                                             onnet mou 8
       arpu 7
                 arpu 8
7
     1349.850
               3171.480
                                                                    52.29
                           500.0
                                         57.84
                                                      54.68
97
      294.023
                183.043
                             0.0
                                        433.59
                                                     415.66
                                                                   221.06
      146.073
                  0.000
                             0.0
                                         55.19
                                                       3.26
                                                                      NaN
111
143
       39.981
                   0.000
                             0.0
                                      1325.91
                                                      28.61
                                                                      NaN
188
      183.668
                   0.000
                             0.0
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                                                       0.98
                                                                      NaN
                  offnet mou 6 offnet mou 7 offnet mou 8
     onnet mou 9
offnet mou 9
7
             NaN
                         453.43
                                        567.16
                                                      325.91
NaN
97
             NaN
                          74.54
                                         43.66
                                                       31.86
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```

111	NaN	45.51	12.34	NaN	
NaN 143	NaN	13.91	1.89	NaN	
NaN	nan	13.31	1103	Hall	
188	NaN	105.16	39.39	NaN	
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7 97 111 143 188	roam_ic_mou_6 16.23 0.00 0.00 0.00 0.00	roam_ic_mou_7 33.49 0.00 0.00 8.94 0.00	roam_ic_mou_ 31.6 6.1 Na Na Na	4	u_9 \ NaN NaN NaN NaN
7 97 111 143 188	roam_og_mou_6 23.74 0.00 0.00 0.00 0.00	roam_og_mou_7 12.59 0.00 0.00 8.53 0.00	roam_og_mou_ 38.0 23.9 Na Na	6	u_9 \ NaN NaN NaN NaN
	loc_og_t2t_mou_6	oloc_og_t2t_	_mou_7 loc_og	_t2t_mou_8	
loc_ 7	og_t2t_mou_9 \ 51.39	)	31.38	40.28	
NaN	31.35	9	31.30	40.20	
97	2.83	3	16.19	9.73	
NaN	FF 10		2.26	N = N	
111 NaN	55.19	)	3.26	NaN	
143	18.89	)	6.83	NaN	
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188 NaN	4.38	3	0.98	NaN	
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	loc_og_t2m_mou_0	oloc_og_t2m_	_mou_7 loc_og	_t2m_mou_8	
loc_ 7	og_t2m_mou_9 \		147 20	162 20	
NaN	308.63	) 4	147.38	162.28	
97	16.99	)	23.14	17.79	
NaN	40.00				
111 NaN	43.83	3	12.34	NaN	
143	8.58	3	1.56	NaN	
NaN					
188	99.83	L	38.98	NaN	
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	loc_og_t2f_mou_0	loc_og_t2f_	_mou_7 loc_og	_t2f_mou_8	
	$\log_{12}f_{mou_{9}}$		FF 14	F2 22	
7	62.13	5	55.14	53.23	

NaN				
97	3.54	1.46		1.83
NaN				
111	0.00	0.00		NaN
NaN				
143	0.00	0.00		NaN
NaN				
188	5.34	0.41		NaN
NaN				
	100 00 +20 may 6	loc og +2c mou T	1 100 0	a +2c mau 0
100.0	loc_og_t2c_mou_6	toc_og_tzc_iiiou_/	100_0	g_t2c_iiiou_8
7	og_t2c_mou_9 \ 0.00	0.0	<b>\</b>	0.0
, NaN	0.00	0.0		0.0
97	0.40	0.0	1	0.0
NaN	0.40	0.0		0.0
111	0.00	0.0		NaN
NaN	0.00	0.0		IVAIV
143	2.09	0.0		NaN
NaN	2.09	0.0		IVAIV
188	0.00	0.0		NaN
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7 4.30 97 430.7		533.91 40.81	255.79 29.36	NaN NaN
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143 1307.		0133	IVAIV	IVAIN
188	109.54	40.38	NaN	NaN
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	std_og_t2t_mou_7	std_og_t2t_mou_8	std_o	g_t2t_mou_9
_	g_t2m_mou_6 \			
7	23.29	12.01		NaN
49.89				
97	399.46	191.31		NaN
53.59		21.		<b>A</b> 1
111	0.00	NaN		NaN
0.00	10.50	N. A		N - N
143	13.58	NaN		NaN
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188	0.00	NaN		NaN
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	std og t2m mou 7	std og t2m mou s	std o	g t2m mou 9
	5 ca_0g_czm_mou_/	3 ca_0g_czm_mou_0	, J.Ca_0	9

std_og_t2f 7	_mou_6 \ 31.76	49.14	1	NaN
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97	13.81	8.33	ı	NaN
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143	0.00	NaN	,	NaN
0.00	0.00	IValv	· ·	vaiv
	0.00	N-N		I - N
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c+d o	a +2f mau 7	s+d og +2f mau 0	c+d og +2f mou	. 0
		std_og_t2f_mou_8	Sta_og_tz1_iiiot	1_9
std_og_t2c		10.00		I - N
7	20.08	16.68		NaN
0.0	0.00	0.00		1 - 31
97	0.00	0.00		NaN
0.0				
111	0.00	NaN		NaN
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143	0.00	NaN	ľ	laN
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188	0.00	NaN	1	laN
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std_o	g_t2c_mou_7	std_og_t2c_mou_8	std_og_t2c_mou	<b>_</b> 9
std_og_mou	_6 \			
7	0.0	0.0	1	laN
60.86				
97	0.0	0.0	ľ	NaN
484.36				
111	0.0	NaN	1	NaN
1.30				
143	0.0	NaN	ı	NaN
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188	0.0	NaN	ı	NaN
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std o	a mou 7 std (	og mou 8 std og	mou 9 isd oa r	nou 6
isd_og_mou		. <u></u>		
7		77.84	NaN	0.0
0.18	75111	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	.10.1	0.10
97	413.28	199.64	NaN	0.0
0.00	713.20	100.07	IVUIV	0.0
111	0.00	NaN	NaN	0.0
0.00	0.00	INGIN	IVAIV	0.0
143	13.58	NaN	NaN	0.0
	13.30	INGIN	IVAIV	0.0
0.00	0.00	NoN	NaM	0.0
188	0.00	NaN	NaN	0.0
0.00				

i	.sd_og_mou_8 isd_c	g_mou_9 sp	l_og_mou_6 s	pl_og_mou_7	
spl_og	_mou_8 \				
7	10.01	NaN	4.50	0.00	
6.50 97	0.00	NaN	2.54	11.81	
2.01	0.00	Ivaiv	2.34	11.01	
111	NaN	NaN	0.38	2.71	
NaN	-	-			
143	NaN	NaN	3.38	0.00	
NaN					
188	NaN	NaN	0.00	0.00	
NaN					
\ \	pl_og_mou_9 og_ot	hers_6 og_c	others_7 og_	others_8 o	g_others_9
7	NaN	0.00	0.0	0.0	NaN
97	NaN	0.86	0.0	0.0	NaN
111	NaN	1.29	0.0	NaN	NaN
143	NaN	1.20	0.0	NaN	NaN
188	NaN	0.00	0.0	NaN	NaN
	otal_og_mou_6 tot				og_mou_9 \
7	487.53	609.24		. 16	0.0
97	511.16	465.91		.03	0.0 0.0
111 143	102.01 1341.03	18.33 21.98		.00 .00	0.0
188	109.54	40.38		.00	0.0
					0.0
l	oc_ic_t2t_mou_6 l	.oc_ic_t2t_m	ou_7 loc_ic_	t2t_mou_8	
	_t2t_mou_9 \	2.7	2.00	27 21	
7 NaN	58.14	34	2.26	27.31	
97	11.61	31	2.89	4.46	
NaN	11.01	32	2105	11.10	
111	50.01	16	5.66	NaN	
NaN					
143	30.19		7.06	NaN	
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188 NaN	21.10	13	) <b>.</b> 44	IValV	
	oc_ic_t2m_mou_6 l	.oc_ic_t2m_mo	ou_7 loc_ic_	t2m_mou_8	
_	_t2m_mou_9 \	22.	1 40	121 10	
7	217.56	22.	1.49	121.19	

97				
NaN	NaN			
111 160.68 58.53 NaN NaN 143 27.98 1.35 NaN 188 217.03 56.63 NaN NaN 10c_ic_t2f_mou_6 loc_ic_t2f_mou_7 loc_ic_t2f_mou_8 loc_ic_t2f_mou_9 \ 152.16 101.46 39.53 NaN NaN 111 5.06 0.40 NaN NaN 111 5.06 0.40 NaN NaN 123 10.13 0.00 NaN NaN 188 18.28 2.94 NaN NaN 188 18.28 2.94 NaN NaN 188 18.28 2.94 NaN NaN 188 18.28 355.23 188.04 Na 36.89 97 29.54 60.48 31.09 Na 10.00 111 215.76 75.59 NaN Na 10.00 125.56 188 256.49 73.03 NaN Na 125.56 188 256.49 73.03 NaN Na NaN NaN 100 std_ic_t2t_mou_6 \ 10 .00 11 215.76 75.59 NaN Na Na Na 100 00 111 0.00 NaN Na	97	16.94	26.94	26.63
NaN 143	NaN			
143	111	160.68	58.53	NaN
NaN 188				
188		27.98	1.35	NaN
NaN  loc_ic_t2f_mou_6 loc_ic_t2f_mou_7 loc_ic_t2f_mou_8  loc_ic_t2f_mou_9 \ 7		217 02	FC C2	MaN
loc_ic_t2f_mou_6 loc_ic_t2f_mou_7 loc_ic_t2f_mou_8 loc_ic_t2f_mou_9 \ 7		217.03	50.03	Nan
	Nan			
		loc ic t2f mou 6 lo	ocic t2f mou 7 l	oc ic t2f mou 8
7	loc		,c_1c_c21ou_,	00_10_01
NaN 97 0.98 0.63 0.00 NaN 111 5.06 0.40 NaN 111 5.06 0.40 NaN 143 10.13 0.00 NaN 188 18.28 2.94 NaN 188 18.28 2.94 NaN NaN 188 18.28 355.23 188.04 Nal 36.89 97 29.54 60.48 31.09 NaN Nal 9.00 NaN NaN Nal 25.56 188 256.49 73.03 NaN NaN Nal 25.56 188 256.49 73.03 NaN NaN Nal 9.00 Std_ic_t2t_mou_6 7 11.83 30.39 NaN Nal 9.00 NaN Nal 9.00 NaN NaN NaN Nal 9.00 NaN NaN NaN NaN NaN NaN NaN Nal 9.00 NaN NaN NaN NaN NaN NaN NaN NaN NaN N	7		101.46	39.53
NaN	NaN			
111 5.06 0.40 NaN NaN 143 10.13 0.00 NaN NaN 188 18.28 2.94 NaN NaN 188 18.28 2.94 NaN NaN    loc_ic_mou_6 loc_ic_mou_7 loc_ic_mou_8 loc_ic_mou_9   std_ic_t2t_mou_6	97	0.98	0.63	0.00
NaN	NaN			
143       10.13       0.00       NaN         NaN       188       18.28       2.94       NaN         loc_ic_mou_6       loc_ic_mou_7       loc_ic_mou_8       loc_ic_mou_9         std_ic_t2t_mou_6       355.23       188.04       Nal         36.89       97       29.54       60.48       31.09       Nal         0.49       111       215.76       75.59       NaN       Nal         0.00       143       68.31       8.41       NaN       Nal         25.56       188       256.49       73.03       NaN       Nal         0.00       std_ic_t2t_mou_7       std_ic_t2t_mou_8       std_ic_t2t_mou_9         std_ic_t2m_mou_6       7       11.83       30.39       NaN         91.44       97       1.36       1.06       NaN         90.00       111       0.00       NaN       NaN         143       0.00       NaN       NaN         0.00       0.00       NaN       NaN         188       0.00       NaN       NaN         0.00       0.00       NaN       NaN         0.00       0.00       NaN       NaN	111	5.06	0.40	NaN
NaN 188 18.28 2.94 NaN 1818 18.28 2.94 NaN NaN NaN NaN NaN NaN NaN NaN NaN Na	NaN			
188       18.28       2.94       NaN         NaN       loc_ic_mou_6 loc_ic_mou_7 loc_ic_mou_8 loc_ic_mou_9         std_ic_t2t_mou_6       355.23       188.04       Nal         36.89       7       29.54       60.48       31.09       Nal         0.49       111       215.76       75.59       NaN       Nal         0.00       143       68.31       8.41       NaN       Nal         25.56       188       256.49       73.03       NaN       Nal         0.00       std_ic_t2t_mou_7       std_ic_t2t_mou_8       std_ic_t2t_mou_9         std_ic_t2m_mou_6       7       11.83       30.39       NaN         91.44       97       1.36       1.06       NaN         0.00       111       0.00       NaN       NaN         0.00       143       0.00       NaN       NaN         0.00       188       0.00       NaN       NaN         0.00       0.00       NaN       NaN	143	10.13	0.00	NaN
NaN  loc_ic_mou_6 loc_ic_mou_7 loc_ic_mou_8 loc_ic_mou_9  std_ic_t2t_mou_6 7		10.00	2.04	
loc_ic_mou_6 loc_ic_mou_7 loc_ic_mou_8 loc_ic_mou_9 std_ic_t2t_mou_6		18.28	2.94	NaN
std_ic_t2t_mou_6     355.23     188.04     Nal       36.89     97     29.54     60.48     31.09     Nal       0.49     111     215.76     75.59     NaN     Nal       0.00     143     68.31     8.41     NaN     Nal       25.56     188     256.49     73.03     NaN     Nal       0.00     std_ic_t2t_mou_7     std_ic_t2t_mou_8     std_ic_t2t_mou_9       std_ic_t2m_mou_6     7     11.83     30.39     NaN       91.44     97     1.36     1.06     NaN       90.00     11     0.00     NaN     NaN       111     0.00     NaN     NaN       0.00     NaN     NaN       143     0.00     NaN     NaN       0.00     NaN     NaN       188     0.00     NaN     NaN	Nan			
36.89 97	_	ic_t2t_mou_6 \		
97			333.23	TOT INGI
0.49 111	97		60.48 31	.09 NaN
0.00 143 68.31 8.41 NaN Nal 25.56 188 256.49 73.03 NaN NaN 0.00  std_ic_t2t_mou_7 std_ic_t2t_mou_8 std_ic_t2t_mou_9 std_ic_t2m_mou_6 \ 7 11.83 30.39 NaN 91.44 97 1.36 1.06 NaN 0.00 111 0.00 NaN NaN 0.00 143 0.00 NaN NaN 0.00 148 0.00 NaN NaN 0.00 188 0.00 NaN NaN	0.49			
143       68.31       8.41       NaN       Nal         25.56       188       256.49       73.03       NaN       Nal         0.00       std_ic_t2t_mou_8 std_ic_t2t_mou_9         std_ic_t2m_mou_6 \       7       11.83       30.39       NaN         91.44       97       1.36       1.06       NaN         0.00       111       0.00       NaN       NaN         0.00       143       0.00       NaN       NaN         0.00       188       0.00       NaN       NaN         0.00       188       0.00       NaN       NaN	111	215.76	75.59	NaN NaN
25.56 188				
188	143		8.41	NaN NaN
0.00       std_ic_t2t_mou_7 std_ic_t2t_mou_8 std_ic_t2t_mou_9 std_ic_t2m_mou_6 \         7 11.83 30.39 NaN         91.44         97 1.36 1.06 NaN         0.00         111 0.00 NaN NaN         0.00         143 0.00 NaN NaN         0.00         188 0.00 NaN NaN         0.00			72.02	
std_ic_t2t_mou_7       std_ic_t2t_mou_8       std_ic_t2t_mou_9         std_ic_t2m_mou_6       \\ 7       11.83       30.39       NaN         91.44       \\ 97       1.36       1.06       NaN         0.00       \\ 111       0.00       NaN       NaN         0.00       \\ 143       0.00       NaN       NaN         0.00       \\ 188       0.00       NaN       NaN         0.00       \\ \>       NaN       NaN         0.00       \\ \>       NaN       NaN			/3.03	nan Nal
std_ic_t2m_mou_6     11.83     30.39     NaN       91.44     1.36     1.06     NaN       0.00     NaN     NaN       111     0.00     NaN     NaN       0.00     NaN     NaN       0.00     NaN     NaN       188     0.00     NaN     NaN       0.00     NaN     NaN	0.00			
91.44 97 1.36 1.06 NaN 0.00 111 0.00 NaN NaN 0.00 143 0.00 NaN NaN 0.00 188 0.00 NaN NaN		ic_t2m_mou_6 \		
97 1.36 1.06 NaN 0.00 111 0.00 NaN NaN 0.00 143 0.00 NaN NaN 0.00 188 0.00 NaN NaN 0.00	7		30.39	NaN
0.00 111			1 00	
111 0.00 NaN NaN 0.00 143 0.00 NaN NaN 0.00 188 0.00 NaN NaN 0.00			1.06	NaN
0.00 143 0.00 NaN NaN 0.00 188 0.00 NaN NaN 0.00			N - N	NI NI
143 0.00 NaN NaN 0.00 188 0.00 NaN NaN 0.00			INali	ivaiv
0.00 188 0.00 NaN NaN 0.00			MaM	Mall
188 0.00 NaN NaN 0.00			IVAIV	IVAIV
0.00			NaN	NaN
			ITAIT	Han
std_ic_t2m_mou_7 std_ic_t2m_mou_8 std_ic_t2m_mou_9	3.00			
		std_ic_t2m_mou 7 st	d_ic_t2m_mou 8 s	td_ic_t2m_mou 9
			<b>_</b>	<b></b>

std_ic_t2f_m		141 22		N - N
7	126.99	141.33		NaN
52.19	4 10	0.00		N - N
97	4.16	0.00		NaN
0.00	0.00	NI - NI		NI - NI
111	0.00	NaN		NaN
1.13	0.00			
143	0.00	NaN		NaN
0.00				
188	0.00	NaN		NaN
0.00				
				0
		std_ic_t2f_mou_8	std_1c_t2t_m	ou_9
std_ic_t2o_m		22 21		
7	34.24	22.21		NaN
0.0	0.00	0.00		
97	0.00	0.00		NaN
0.0				
111	0.00	NaN		NaN
0.0				
143	0.00	NaN		NaN
0.0				
188	0.00	NaN		NaN
0.0				
				_
		std_ic_t2o_mou_8	std_ic_t2o_m	ou_9
std_ic_mou_6				
7	0.0	0.0		NaN
180.54				
97	0.0	0.0		NaN
0.49				
111	0.0	NaN		NaN
1.13				
143	0.0	NaN		NaN
25.56				
	A A	NaN		
188	0.0	NaN		NaN
188 0.00	0.0	Ivalv		NaN
0.00			0 1	
0.00 std_ic_	mou_7 std		mou_9 total_	
0.00 std_ic_total_ic_mou	mou_7 std _7 \	_ic_mou_8 std_ic_r		ic_mou_6
0.00  std_ic_ total_ic_mou 7 1	mou_7 std		mou_9 total_ NaN	
0.00 std_ic_ total_ic_mou 7 1 558.04	mou_7 std _7 \ 73.08	_ic_mou_8	 NaN	ic_mou_6 626.46
0.00 std_ic_ total_ic_mou 7 1 558.04 97	mou_7 std _7 \	_ic_mou_8 std_ic_r		ic_mou_6
0.00 std_ic_ total_ic_mou 7 1 558.04 97 67.84	mou_7 std _7 \ 73.08 5.53	_ic_mou_8 std_ic_r 193.94 1.06	NaN NaN	ic_mou_6 626.46 32.04
0.00 std_ic_ total_ic_mou 7 1 558.04 97 67.84 111	mou_7 std _7 \ 73.08	_ic_mou_8	 NaN	ic_mou_6 626.46
std_ic_ total_ic_mou 7 1 558.04 97 67.84 111 75.59	mou_7 std _7 \ 73.08 5.53 0.00	_ic_mou_8 std_ic_r 193.94 1.06 NaN	NaN NaN NaN	ic_mou_6 626.46 32.04 217.04
std_ic_ total_ic_mou 7 1 558.04 97 67.84 111 75.59	mou_7 std _7 \ 73.08 5.53	_ic_mou_8 std_ic_r 193.94 1.06	NaN NaN	ic_mou_6 626.46 32.04
0.00 std_ic_ total_ic_mou 7 1 558.04 97 67.84 111 75.59 143 8.41	mou_7 std_ _7 \ 73.08 5.53 0.00	_ic_mou_8	NaN NaN NaN NaN	ic_mou_6 626.46 32.04 217.04 93.88
0.00 std_ic_ total_ic_mou 7 1 558.04 97 67.84 111 75.59 143 8.41 188	mou_7 std _7 \ 73.08 5.53 0.00	_ic_mou_8 std_ic_r 193.94 1.06 NaN	NaN NaN NaN	ic_mou_6 626.46 32.04 217.04
0.00 std_ic_ total_ic_mou 7 1 558.04 97 67.84 111 75.59 143 8.41	mou_7 std_ _7 \ 73.08 5.53 0.00	_ic_mou_8	NaN NaN NaN NaN	ic_mou_6 626.46 32.04 217.04 93.88

	total ic mou 8	total ic mou 9	spl ic mou 6	spl ic mou 7
	c_mou_8  \			
7	428.74	0.0	0.21	0.0
0.0	22 10	0.0	0.62	0.0
97 0.0	32.16	0.0	0.63	0.0
111	0.00	0.0	0.00	0.0
NaN	0.00	0.0	0.00	0.0
143	0.00	0.0	0.00	0.0
NaN				
188	0.00	0.0	0.00	0.0
NaN				
,	splic mou 9 is	d ic mou 6 isc	d ic mou 7 isc	lic mou 8
isd_i	c_mou_9 \			
7	NaN	2.06	14.53	31.59
NaN	NeN	0.00	0.00	0.00
97 NaN	NaN	0.00	0.00	0.00
111	NaN	0.00	0.00	NaN
NaN	11011	0.00	0100	nan.
143	NaN	0.00	0.00	NaN
NaN				
188	NaN	0.00	0.00	NaN
NaN				
:	ic others 6 ic	others 7 ic ot	thers 8 ic oth	ners 9
	_rech_num_6 \			_
7	15.74	15.19	15.14	NaN
5	1 20	1 00	0.00	N - N
97 14	1.36	1.83	0.00	NaN
111	0.15	0.00	NaN	NaN
12	0113	0.00	nan-	Han
143	0.00	0.00	NaN	NaN
31				
188	0.00	0.00	NaN	NaN
6				
	total rech num 7	total rech nu	ım 8 total red	ch num 9
	rech_amt_ $\overline{6}$ \			
7	5		7	3
1580			1.4	2
97	17		14	3
432 111	8		5	2
704	0		5	2
143				
143	6		4	2

188 864	1	0	0	
		al_rech_amt_8 total	l_rech_amt_9	
<pre>max_rech_am 7</pre>	t_6 \ 790	3638	0	
1580 97	328	206	0	
36 111	178	0	0	
154 143	40	0	0	
90 188	120	0	Θ	
252				
<pre>max_re last day rc</pre>		ech_amt_8 max_rech_	_amt_9	
7 0	790	1580	0	
97	44	36	Θ	
30 111	50	0	0	
154 143	30	0	0	
10 188	120	0	0	
252				
last_d vol 2g mb 6		ast_day_rch_amt_8	last_day_rch_amt_9	
7 0.00	0	779	0	
97 0.00	20	0	0	
111	30	0	0	
284.50 143	0	0	0	
0.00 188	120	0	0	
58.44				
_vol_2g vol_3g_mb_7	\	b_8 vol_2g_mb_9 vo		
7	0.0	0.0	0.0	0.0
97	0.0	0.0	0.0	0.0
111	0.0	0.0	0.0	0.0

143	0.0	0.0	0.0	0.0	0.0
188	0.0	0.0	0.0	1522.4	0.0
vol_3g_ monthly_2g_8		vol_3g_mb_9 m	onthly_2g_6	monthly_2g_7	
7	0.0	0.0	Θ	0	
0 97	0.0	0.0	0	0	
0					
111 0	0.0	0.0	1	0	
143	0.0	0.0	Θ	0	
0 188	0.0	0.0	Θ	0	
0					
	_2g_9	sachet_2g_6	sachet_2g_7	sachet_2g_8	sachet_2g_9
7	0	0	0	0	Θ
97	0	0	0	0	Θ
111	0	0	0	Θ	0
143	0	0	0	0	Θ
188	0	Θ	0	0	0
monthly sachet_3g_6	_3g_6	monthly_3g_7	monthly_3g_	8 monthly_3g_	_9
7	0	Θ		0	0
97	0	Θ		0	0
0					
111 1	0	0		0	0
143	0	Θ		0	0
0 188	2	0		0	0
0	_	0		·	
sachet	3q 7	sachet_3g_8 s	achet 3g 9	aon aug_vbc_3	Bq
jul_vbc_3g	\				
7 19.38	0	0	0	802 57.7	4
97 0.00	0	0	0	502 0.0	00
0.00					

```
111
                  0
                                  0
                                                     332
                                                                    0.00
0.00
143
                  0
                                                      264
                                                                    0.00
0.00
188
                  0
                                                  0
                                                     244
                                                                    0.00
831.48
                                   avg rech amt 6 7
      jun vbc 3g
                    sep vbc 3g
7
            18.74
                             0.0
                                                1185.0
97
                             0.0
             0.00
                                                 380.0
111
             0.00
                             0.0
                                                 441.0
143
             0.00
                             0.0
                                                 418.0
188
         1223.04
                             0.0
                                                 492.0
df null mou 9.shape
(1590, 178)
# Deleting the records for which MOU for Sep(9) are null
df = df.drop(df null mou 9.index)
# Again Cheking percent of missing values in columns
df missing columns =
(round(((df.isnull().sum()/len(df.index))*100),2).to frame('null')).so
rt_values('null', ascending=False)
df missing columns
                      null
isd og mou 8
                      0.55
roam ic mou 8
                      0.55
loc og mou 8
                      0.55
std_ic_t2o_mou_8
                      0.55
roam_og_mou_8
                      0.55
. . .
                       . . .
total og mou 9
                      0.00
total_og_mou_8
                      0.00
total og mou 7
                      0.00
total og mou 6
                      0.00
avg rech amt 6 7
                      0.00
[178 rows x 1 columns]
# Listing the columns of MOU Aug(8)
print(((df missing columns[df missing columns['null'] ==
0.55]).index).to list())
['isd_og_mou_8', 'roam_ic_mou_8', 'loc_og_mou_8', 'std_ic_t2o_mou_8',
'roam_og_mou_8', 'loc_ic_t2f_mou_8', 'loc_og_t2t_mou_8',
'std_ic_t2f_mou_8', 'std_og_t2m_mou_8', 'loc_og_t2m_mou_8',
'std_og_t2t_mou_8', 'std_ic_t2m_mou_8', 'loc_og_t2f_mou_8',
'spl og mou 8', 'loc ic mou 8', 'loc og t2c mou 8',
```

```
'std_ic_t2t_mou_8', 'loc_ic_t2m_mou_8', 'std_og_t2f_mou_8',
'spl_ic_mou_8', 'std_ic_mou_8', 'offnet_mou_8', 'ic_others_8',
'og_others_8', 'loc_ic_t2t_mou_8', 'onnet_mou_8', 'isd_ic_mou_8',
'std og t2c mou 8', 'std og mou 8']
# Creating a dataframe with the condition, in which MOU for Aug(8) are
null
df null mou 8 = df[(df['loc og t2m mou 8'].isnull()) &
(df['loc ic t2f mou 8'].isnull()) & (df['roam og mou 8'].isnull()) &
(df['std ic t2m_mou_8'].isnull()) &
  (df['loc og t2t mou 8'].isnull()) &
(df['std_ic_t2t_mou_8'].isnull()) & (df['loc_og_t2f_mou_8'].isnull())
& (df['loc ic mou 8'].isnull()) &
  (df['loc og t2c mou 8'].isnull()) & (df['loc og mou 8'].isnull()) &
(df['std og t2t mou 8'].isnull()) & (df['roam ic mou 8'].isnull()) &
  (df['loc ic t2m mou 8'].isnull()) &
(df['std og t2m mou 8'].isnull()) & (df['loc ic t2t mou 8'].isnull())
& (df['std og t2f mou 8'].isnull()) &
  (df['std og t2c mou 8'].isnull()) & (df['og others 8'].isnull()) &
(df['std og mou 8'].isnull()) & (df['spl og mou 8'].isnull()) &
  (df['std\ ic\ t2f\ mou\ 8'].isnull()) \& (df['isd\_og\_mou\_8'].isnull()) \&
(df['std ic mou 8'].isnull()) & (df['offnet mou 8'].isnull()) &
  (df['isd ic mou 8'].isnull()) & (df['ic others 8'].isnull()) &
(df['std ic t2o mou 8'].isnull()) & (df['onnet mou 8'].isnull()) &
  (df['spl ic mou 8'].isnull())]
df null mou 8.head()
      mobile number loc_og_t2o_mou std_og_t2o_mou loc_ic_t2o_mou
arpu 6
375
         7002252754
                                  0.0
                                                   0.0
                                                                    0.0
580.477
                                  0.0
                                                                    0.0
578
         7000248548
                                                   0.0
569,612
788
                                  0.0
                                                                    0.0
         7000636808
                                                   0.0
532,742
1802
                                  0.0
                                                   0.0
                                                                    0.0
         7000516213
810.455
4837
         7002192662
                                  0.0
                                                   0.0
                                                                    0.0
649.150
                         arpu 9
                                  onnet mou 6
                                                onnet mou 7
                                                              onnet mou 8
       arpu 7
               arpu 8
375
      111.878
                   0.0
                        378.881
                                       249.43
                                                      39.64
                                                                      NaN
                                                                      NaN
578
      237.289
                   0.0
                          4.440
                                       718.01
                                                     212.73
788
      546.756
                   0.0
                        269.274
                                      1173.39
                                                     891.83
                                                                      NaN
                                                                      NaN
1802
        0.000
                   0.0
                          0.000
                                        91.33
                                                        NaN
```

4837	149.572	0.0	9.250	1354.24		85.13		NaN
4037	149.572	0.0	3.230	1334.24		05.15		IVAIV
offne	onnet_mou_9 t mou 9 \	offnet_	_mou_6 o	ffnet_mou_	7 offr	net_mou_8		
375	245.06		62.24	37.24	4	NaN		
144.53 578	0.00	4	487.06	139.7	1	NaN		
1.26 788	149.34		61.59	137.14	4	NaN		
428.30 1802	0.00	13	371.04	Nal	N	NaN		
0.00 4837	0.43		50.63	37.13	3	NaN		
0.00								
375 578 788	roam_ic_mou_ 25.4 0.0 0.0	49 90	ic_mou_7 19.43 2.01 1.48		mou_8 NaN NaN NaN	roam_ic_m	0.00 6.43 0.00	\
1802 4837	1.2 0.0		NaN 12.84		NaN NaN		0.00 1.25	
375 578 788 1802 4837	roam_og_mou_ 312.5 0.0 0.0 11.2 0.0	59 90 90 23	_og_mou_7 78.58 6.30 14.43 NaN 44.78		mou_8 NaN NaN NaN NaN NaN	roam_og_m	0.00 1.26 0.00 3.91 0.43	\
	loc_og_t2t_r		oc_og_t2t	_mou_7 lo	c_og_t2	2t_mou_8		
375	g_t2t_mou_9	0.00		0.00		NaN		
11.54 578		11.28		27.89		NaN		
0.00 788	3	31.06		27.49		NaN		
7.39 1802		17.86		NaN		NaN		
0.00 4837		6.71		1.35		NaN		
0.00		J. / I		1.55		IVAIV		
loc o	loc_og_t2m_n g t2m mou 9	nou_6 lo	oc_og_t2m	_mou_7 lo	c_og_t2	2m_mou_8		
375 25.31		0.00		0.00		NaN		
578 0.00		12.24		46.94		NaN		

788	34.66	60.86	NaN
34.23	0.4 ==	••	
.802	84.51	NaN	NaN
.00 837	15 10	15 76	NaN
	15.18	15.76	Nan
.00			
	loc_og_t2f_mou_6	loc_og_t2f_mou_7	loc_og_t2f_mou_8
	_t2f_mou_9 \		
75	0.0	0.0	NaN
. 0	2 2	2.2	NI NI
78	0.0	0.0	NaN
. 0 38	0.0	0.0	NaN
0	0.0	0.0	INdIV
802	0.0	NaN	NaN
0	0.10	HUIV	14014
37	0.0	0.0	NaN
0			
	loc oa t2c mou 6	loc og t2c mou 7	loc og t2c mou 8
	t2c mou 9 \		
'5	0.00	0.0	NaN
11			
8	2.33	0.0	NaN
00			
8	0.00	0.0	NaN
58 92	10.20	NaN	NaN
92	10.29	IValV	Ivaiv
37	0.00	0.0	NaN
00	3.30	310	11011
	loc og mou 6 loc	og mou 7 100 00	mou 9 loc og mou 0
5		_0g_   0u_/	mou_8 loc_og_mou_9 NaN 36.86
8	53.53	74.84	NaN 0.00
8	65.73	88.36	NaN 41.63
92	102.38	NaN	NaN 0.00
37	21.89	17.11	NaN 0.00
	std og t2t mou 6	std og t2t mou 7	std og t2t mou 8
	t2t mou 9 \		
5 5	0.00	0.00	NaN
3.51			
8	706.73	178.53	NaN
90	4440.00	0=1.65	
3	1142.33	854.08	NaN
1.94 92	72 46	NaN	NaN
92 90	73.46	INDIN	INdIV
50			

4837	1347.53	48.48	NaN
0.00			
st	d_og_t2m_mou <b>_</b> 6	std_og_t2m_mou_7	std_og_t2m_mou_8
std og ti	2m mou 9 \		
375	0.00	0.00	NaN
118.79			
578	442.48	92.76	NaN
0.00	1.21.10	32170	
788	26.93	67.24	NaN
388.54	20.93	07.24	IVAIV
	1207 06	NoN	NaN
1802	1207.86	NaN	NaN
0.00	25 44	11 00	
4837	35.44	11.88	NaN
0.00			
		std_og_t2f_mou_7	std_og_t2f_mou_8
	2f_mou_9 \		
375	0.0	0.0	NaN
0.0			
578	0.0	0.0	NaN
0.0			
788	0.0	0.0	NaN
0.0			
1802	0.0	NaN	NaN
0.0	010	Nan	ivaiv
4837	0.0	0.0	NaN
0.0	0.0	0.0	Ivaiv
0.0			
c+	d og +2c mou 6	std_og_t2c_mou_7	std og t2c mou 8
	a_og_tzt_mou_o 2c mou 9 \	3 td_0g_t2t_1110d_7	3 tu_0g_tzc_mou_0
375	0.0	0.0	NaN
	0.0	0.0	Ivalv
0.0	0.0	0.0	N - N
578	0.0	0.0	NaN
0.0			
788	0.0	0.0	NaN
0.0			
1802	0.0	NaN	NaN
0.0			
4837	0.0	0.0	NaN
0.0			
st	d og mou 6 st	d og mou 7 std og	mou 8 std og mou 9
isd og m			
375	0.00	0.00	NaN 352.31
0.0	5.00		332131
578	1149.21	271.29	NaN 0.00
0.0	1177.21	211.23	14014 0.00
	1160 26	021 22	NaN 530.49
788	1169.26	921.33	NaN 530.49
0.0			

1802	1281.33	NaN	NaN	0.00	
0.0					
4837	1382.98	60.36	NaN	0.00	
0.0					
1		isa_og_mou_8	isd_og_mou_9	spl_og_mou_6	
	g_mou_7 \	NI - NI	0.0	0.00	
375	0.0	NaN	0.0	0.00	
0.00	0.0	N - N	0.0	2 50	
578	0.0	NaN	0.0	2.58	
1.21	0.0	NaN	0.0	0.00	
788	0.0	NaN	0.0	0.00	
4.85 1802	MaN	NaN	0.0	91.94	
NaN	NaN	INdiv	0.0	91.94	
4837	0.0	NaN	0.0	0.00	
0.00	0.0	IValv	0.0	0.00	
0.00					
	spl_og_mou_8	snl na mau 0	og others 6	og others 7	
oa ot	hers 8 \	Spt_og_mod_5	09_0111013_0	og_others_/	
375	NaN	4.78	0.00	0.0	
NaN	Nun	1170	0100	0.0	
578	NaN	0.00	1.55	0.0	
NaN	itait	0.00	1.55	0.0	
788	NaN	5.58	0.00	0.0	
NaN		5.55		0.10	
1802	NaN	0.00	1.53	NaN	
NaN	-				
4837	NaN	0.00	0.00	0.0	
NaN					
	og_others_9	total_og_mou_6	total_og_mou	_7 total_og_mou_8	
375	0.0	0.00			
578	0.0	1206.88			
788	0.0	1234.99	1014.	54 0.0	
1802	0.0	1477.19	0.		
4837	0.0	1404.88	77.	48 0.0	
	_				
	total_og_mou_		mou_6 loc_ic_	t2t_mou_7	
	c_t2t_mou_8 \				
375	393.9	6	0.00	0.00	
NaN					
578	0.0	U	48.01	63.39	
NaN		2	F.4. 10	F2 C4	
788	577.7	1	54.19	52.64	
NaN	0 0	0	17 60	NeN	
1802	0.0	U	17.68	NaN	
NaN	0 0	0 1	04 46	2 15	
4837	0.0	U I	04.46	3.15	
NaN					

	loc ic t2t mou 9	loc ic t2m mou 6	loc ic t2m mou 7	
loc_i 375	Lc_t2m_mou_8 \ 6.74	0.00	0.00	
NaN				
578 NaN	0.00	83.09	64.31	
788 NaN	12.51	54.69	187.96	
1802	0.00	39.46	NaN	
NaN 4837	0.00	162.01	17.94	
NaN				
loc_i	Lc_t2f_mou_8 \	loc_ic_t2f_mou_6	loc_ic_t2f_mou_7	
375 NaN	38.53	0.00	0.00	
578 NaN	0.00	0.00	0.00	
788	81.83	1.16	2.01	
NaN 1802	0.00	0.70	NaN	
NaN 4837	0.00	0.00	0.00	
NaN				
375	loc_ic_t2f_mou_9 0.0	loc_ic_mou_6 loc_ 0.00	_ic_mou_7	_mou_8 \ NaN
578 788	0.0 0.0	131.11 110.06	127.71 242.63	NaN NaN
1802 4837	0.0 0.0	57.84 266.48	NaN 21.09	NaN
4037				NaN
_	lc_t2t_mou_8 \	_ic_t2t_mou_6 std		
375 NaN	45.28	0.00	0.00	
578 NaN	0.00	24.98	46.43	
788 NaN	94.34	14.55	5.48	
1802	0.00	1.88	NaN	
NaN 4837	0.00	35.11	31.96	
NaN				
std i	std_ic_t2t_mou_9 Lc_t2m_mou_8 \	std_ic_t2m_mou_6	std_ic_t2m_mou_7	
375	8.31	0.00	0.00	

NaN				
578	0.00	1.63	16.69	
NaN				
788	25.61	11.49	62.19	
NaN				
1802	0.00	11.98	NaN	
NaN				
4837	0.00	48.48	0.00	
NaN	0.00	.61.16	0.00	
Han				
	std ic t2m mou 9	std ic t2f mou 6	std ic t2f mou 7	
std ic	t2f mou 8 \	0 - 0 0 0 0 0 0	0 10 2 2 2 2 2 3 2 3 2 3 2 3 2 3	
375	27.31	0.00	0.0	
NaN	27.31	0.00	0.10	
578	0.00	0.00	0.0	
NaN	0.00	0.00	0.0	
788	13.93	0.00	0.0	
NaN	13.33	0.00	0.0	
1802	0.00	0.00	NaN	
NaN	0.00	0.00	Ivan	
4837	0.00	0.28	0.0	
NaN	0.00	0.28	0.0	
IVAIV				
	std ic t2f mou 9	std ic t2o mou 6	std_ic_t2o_mou_7	
	t20 mou 8 \	3 tu_1c_t20_1110u_0	3 td_1C_t20_iii0d_7	
375	0.0	0.0	0.0	
NaN	0.0	0.0	0.0	
578	0.0	0.0	0.0	
NaN	0.0	0.0	0.0	
788	0.0	0.0	0.0	
NaN	010	0.0	0.0	
1802	0.0	0.0	NaN	
NaN	0.0	0.0	IVAIV	
4837	0.0	0.0	0.0	
NaN	0.0	0.0	0.0	
IVAIV				
	std ic t2o mou 9	std ic mou 6 std	lic mou 7 std ic	mou 8 \
375	0.0	0.00	0.00	NaN
578	0.0	26.61	63.13	NaN
788	0.0	26.04	67.68	NaN
1802	0.0	13.86	NaN	NaN
4837	0.0	83.88	31.96	NaN
1037	010	03.00	31130	nan
	std ic mou 9 tot	al ic mou 6 total	. ic mou 7 total :	ic mou 8 \
375	35.63	0.00	0.00	0.0
578	0.00	157.73	190.84	0.0
788	39.54	140.74	310.31	0.0
1802	0.00	71.71	0.00	0.0
4837	0.00	350.36	53.06	0.0
.00,	0.00	550.50	55.00	0.0

1		spl_ic_mou_6	spl_ic_mou_7 sp	ol_ic_mou_8
375	c_mou_9 \ 80.91	0.00	0.0	NaN
0.00				
578 0.00	0.00	0.00	0.0	NaN
788	134.14	0.73	0.0	NaN
0.25 1802	0.00	0.00	NaN	NaN
0.00	0.00	0.00	ivaiv	Ivalv
4837 0.00	0.00	0.00	0.0	NaN
ic_oth	isd_ic_mou_6 is ners_6 \		sd_ic_mou_8 isd_	
375 0.00	0.0	0.0	NaN	0.0
578	0.0	0.0	NaN	0.0
0.00	0.0	0.0	NoN	0.0
788 3.89	0.0	0.0	NaN	0.0
1802	0.0	NaN	NaN	0.0
0.00 4837	0.0	0.0	NaN	0.0
0.00				
	ic others 7 ic	others 8 ic	others 9 total r	rech num 6 \
375	0.0 0.0	NaN NaN	0.0 0.0	$\begin{array}{cc} - & \overline{17} \\ & 19 \end{array}$
578 788	0.0	NaN NaN	0.0	19
1802	NaN	NaN	0.0	21
4837	0.0	NaN	0.0	11
± - ± - 1		<pre>total_rech_</pre>	num_8 total_rech	n_num_9
375	_rech_amt_6 \ 6	5	3	11
700	10		0	4
578 717	16	)	0	4
788	7	7	4	5
714 1802	3	3	0	Θ
955				
4837 666	6		3	4
may r	total_rech_amt_7 ech amt 6 \	<pre>total_rech_</pre>	amt_8 total_rech	n_amt_9
375	136	)	0	440
80				

578	220		0		0	
110 788	494		0	<b>3</b> .	36	
128	494		U	٥.	30	
1802	Θ		Θ		0	
110						
4837	176		0		0	
110						
	max rech amt 7 m	nax rech	amt 8 max	rech amt 9		
last	day rch amt 6 \	idX_i ccii_	ame_o max_	reen_ame_s		
375	50		0	50		
30						
578	50		0	0		
27 788	128		0	130		
128	120		U	130		
1802	0		0	0		
30	-		-	-		
4837	110		0	0		
20						
	last_day_rch_amt_	7 last	day rch amt	8 last day re	ch amt 0	
vol 2	g_mb_6 \	_/ tast_	uay_r cn_ame_	_o cast_day_i	cn_amc_9	
375	5·	0		0	30	
0.0						
578	3	30		0	0	
0.0 788		0		0	120	
0.0		0		0	130	
1802		0		0	0	
0.0		-		-		
4837		0		0	0	
0.0						
	vol_2g_mb_7 vol_	2a mb 8	vol 2a mb (	9 vol 3a mb 6	vol 3a	mb 7
\	**************************************		**************************************	5	<b>1</b> 01_39_	
375	0.0	0.0	0.0	0.0		0.0
578	0.0	0.0	0.0	0.0		0.0
376	0.0	0.0	0.0	0.0		0.0
788	0.0	0.0	0.0	0.0		0.0
1000	0.0	0 0				
1802	0.0	0.0	0.0	0.0		0.0
4837	0.0	0.0	0.0	0.0		0.0
	0.0	0.0	31.	310		
		2		6	7	
month	<pre>vol_3g_mb_8 vol_ ly_2g_8 \</pre>	_3g_mb_9	monthly_2g	_6 monthly_2g	_/	
montif	ty_29_0 \					

	0.0	0.0	0	(	)
	0.0	0.0	0	(	)
0 788	0.0	0.0	0	(	)
0 1802	0.0	0.0	0	(	)
0			0		
4837 0	0.0	0.0	0	(	9
monthly	2g 9 sachet	_2g_6 sachet_2g	g 7	sachet 2g 8	sachet 2g 9
\					
375	0	0	0	0	0
578	0	0	0	0	0
788	0	0	0	0	0
1802	0	0	0	0	0
4837	0	0	0	0	0
monthly_ sachet_3g_6 \		y_3g_7 monthly	_3g_8	3 monthly_3g	<b>J_</b> 9
375	0	0	6	9	0
0 578	0	Θ	(	9	0
0					
788 0	0	0	(	9	0
1802	0	0	(	9	0
0 4837	0	0	6	9	0
0					
<pre>sachet_3 jul_vbc_3g \</pre>	g_7 sachet_	3g_8 sachet_3g	_9	aon aug_vbo	c_3g
375	0	0	0 1	1102	0.0
0.0 578	0	0	0	274	0.0
0.0					
788 0.0	0	0	0	936	0.0
1802	0	0	0	755	0.0
0.0 4837	0	0	0	520	0.0
0.0	-				

```
jun_vbc 3q
                    sep_vbc_3g
                                   avg rech amt 6 7
375
               0.0
                              0.0
                                                 415.0
578
               0.0
                              0.0
                                                 468.5
788
               0.0
                              0.0
                                                 604.0
1802
               0.0
                              0.0
                                                 477.5
4837
                              0.0
                                                 421.0
               0.0
# Deleting the records for which MOU for Aug(8) are null
df = df.drop(df null mou 8.index)
# Again cheking percent of missing values in columns
df missing columns =
(round(((df.isnull().sum()/len(df.index))*100),2).to frame('null')).so
rt values('null', ascending=False)
df missing columns
                     null
roam ic mou 6
                     0.44
spl og mou 6
                     0.44
og others 6
                     0.44
loc ic t2t mou 6
                     0.44
loc og t2m mou 6
                     0.44
                       . . .
isd og mou 9
                     0.00
isd og mou 8
                     0.00
std og mou 9
                     0.00
                     0.00
std og mou 8
avg rech amt 6 7 0.00
[178 rows x 1 columns]
# Listing the columns of MOU Jun(6)
print(((df_missing_columns[df missing columns['null'] ==
0.44]).index).to list())
['roam_ic_mou_6', 'spl_og_mou_6', 'og_others_6', 'loc_ic_t2t_mou_6',
'loc_og_t2m_mou_6', 'loc_og_t2c_mou_6', 'loc_ic_t2m_mou_6',
'isd_og_mou_6', 'loc_og_t2t_mou_6', 'std_og_t2m_mou_6',
'loc_ic_t2f_mou_6', 'ic_others_6', 'roam_og_mou_6', 'loc_ic_mou_6',
'std_og_mou_6', 'loc_og_t2f_mou_6', 'isd_ic_mou_6',
'std_ic_t2t_mou_6', 'std_ic_mou_6', 'std_og_t2t_mou_6',
'std_ic_t2o_mou_6', 'std_og_t2f_mou_6', 'std_ic_t2f_mou_6',
'spl ic mou 6', 'onnet mou 6', 'std og t2c mou 6', 'std ic t2m mou 6',
'offnet mou 6', 'loc og mou 6']
# Creating a dataframe with the condition, in which MOU for Jun(6) are
null
df null mou 6 = df[(df['loc og t2m mou 6'].isnull()) &
(df['loc ic t2f mou 6'].isnull()) & (df['roam og mou 6'].isnull()) &
(df['std ic t2m mou 6'].isnull()) &
  (df['loc og t2t mou 6'].isnull()) &
```

```
(df['std ic t2t mou_6'].isnull()) & (df['loc_og_t2f_mou_6'].isnull())
& (df['loc ic mou 6'].isnull()) &
  (df['loc og t2c mou 6'].isnull()) & (df['loc og mou 6'].isnull()) &
(df['std og t2t mou 6'].isnull()) & (df['roam ic mou 6'].isnull()) &
  (df['loc ic t2m mou 6'].isnull()) &
(df['std_og_t2m_mou_6'].isnull()) & (df['loc_ic_t2t_mou_6'].isnull())
& (df['std og t2f mou 6'].isnull()) &
  (df['std og t2c mou 6'].isnull()) & (df['og others 6'].isnull()) &
(df['std og mou 6'].isnull()) & (df['spl og mou 6'].isnull()) &
  (df['std ic t2f mou 6'].isnull()) & (df['isd og mou 6'].isnull()) &
(df['std ic mou 6'].isnull()) & (df['offnet mou 6'].isnull()) &
  (df['isd ic mou 6'].isnull()) & (df['ic others 6'].isnull()) &
(df['std_ic_t2o_mou_6'].isnull()) & (df['onnet_mou_6'].isnull()) &
  (df['spl ic mou 6'].isnull())]
df null mou 6.head()
      mobile number loc og t2o mou std og t2o mou loc ic t2o mou
arpu 6
77
         7001328263
                                 0.0
                                                 0.0
                                                                  0.0
30.000
364
                                 0.0
                                                                  0.0
         7002168045
                                                 0.0
0.000
423
                                 0.0
                                                 0.0
                                                                  0.0
         7000635248
213.802
         7002152278
934
                                 0.0
                                                 0.0
                                                                  0.0
48,000
1187
         7000486275
                                 0.0
                                                 0.0
                                                                  0.0
0.000
                arpu 8
                         arpu 9 onnet mou 6
                                               onnet mou 7
                                                             onnet mou 8
       arpu 7
77
       82.378
               674.950
                        158.710
                                          NaN
                                                      34.23
                                                                  149.69
364
      792.112
               989.368
                        923.040
                                                     433.49
                                                                  198.96
                                          NaN
423
      304.194
               149.710
                        329,643
                                          NaN
                                                      0.00
                                                                    0.00
934
      764.152
               500.030
                        194.400
                                          NaN
                                                      14.24
                                                                   17.48
      757.170
               995.719
1187
                          0.000
                                          NaN
                                                    1366.71
                                                                 2268.91
      onnet mou 9
                   offnet mou 6 offnet mou 7
                                                offnet mou 8
offnet mou 9
77
             6.31
                             NaN
                                         39.44
                                                       179.18
57.68
364
                                                       923.58
           571.99
                             NaN
                                        845.11
828.29
423
             0.00
                             NaN
                                         10.03
                                                         1.45
```

0.34					
934	7.69	NaN	16.99	76.86	
43.64	0.00	NaN	7 70	26 12	
1187 0.00	0.00	NaN	7.78	36.13	
0.00					
77 364	NaN NaN	roam_ic_mou_7 0.0 0.0	roam_ic_mou_8 0.00 0.00	)	0 0
423 934 1187	NaN NaN NaN	0.0 0.0 0.0	0.06 8.81 8.08	D. 0.	0
77 364 423 934 1187	roam_og_mou_6 NaN NaN NaN NaN NaN	roam_og_mou_7 0.0 0.0 0.0 0.0 0.0	roam_og_mou_8 0.00 0.00 0.00 1.50 25.23	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	0 0 0 0
	loc og t2t mou	6 loc og t2t	mou 7 loc og	t2t mou 8	
	g_t2t_mou_9 \				
77	Na	aN	34.23	149.69	
6.31 364 64.73	Na	aN	28.78	7.46	
423 0.00	Na	aN	0.00	0.00	
934	Na	aN	0.08	17.48	
7.69 1187	Na	s M	4.76	46.18	
0.00	INC	AIN .	4.70	40.10	
100.00	loc_og_t2m_mou_ g_t2m_mou_9 \	_6 loc_og_t2m_	_mou_7 loc_og_	_t2m_mou_8	
77	g_cziii_iiiou_9	aN	32.18	101.63	
29.41 364	Na	a Ni	78.78	584.76	
490.7		ZIV	70.70	304.70	
423 0.33	Na	aN	0.00	0.58	
934	Na	aN	16.99	63.23	
39.99 1187	Na	N.	7.78	31.29	
0.00	No	ZIV.	1.10	31.29	
1	loc_og_t2f_mou_	_6 loc_og_t2f_	_mou_7 loc_og_	_t2f_mou_8	
loc_o	g_t2f_mou_9  \ Na	aN	0.91	29.86	
28.26	110				

364	NaN	21.58	9.43	
0.00			51.15	
423	NaN	0.00	0.00	
0.00				
934	NaN	0.00	12.08	
3.65				
1187	NaN	0.00	0.00	
0.00				
	loc og t2c mou 6	loc og t2c mou 7	loc og t2c mou 8	
loc oc	t2c mou 9 \			
77	,_	0.0	3.9	
0.00				
364	NaN	0.0	0.0	
2.78				
423	NaN	0.0	0.0	
0.00	Al Al	0.0	2.2	
934	NaN	0.0	0.0	
0.00 1187	NaN	0.0	0.0	
0.00	IVAIN	0.0	0.0	
0.00				
	loc_og_mou_6 loc	_og_mou_7 loc_og_n	mou_8 loc_og_mou_9	\
77	NaN	$-67.\overline{33}$	$81.\overline{19}$ $-63.\overline{99}$	
364	NaN		91.66 555.44	
423	NaN	0.00	0.58 0.33	
934	NaN		92.79 51.34	
1187	NaN	12.54	77.48 0.00	
	std og t2t mou 6	std_og_t2t_mou_7	std og t2t mou 8	
std og	g_t2t_mou_9 \			
77	NaN	0.00	0.00	
0.00				
364	NaN	404.71	191.49	
507.26		0.00	0.00	
423 0.00	NaN	0.00	0.00	
0.00				
934	NaN	14 16	0 00	
934 0.00	NaN	14.16	0.00	
0.00				
	NaN NaN	14.16 1361.94	0.00 2202.03	
0.00 1187	NaN	1361.94	2202.03	
0.00 1187 0.00	NaN std_og_t2m_mou_6		2202.03	
0.00 1187 0.00 std_og	NaN std_og_t2m_mou_6 g_t2m_mou_9 \	1361.94 std_og_t2m_mou_7	2202.03 std_og_t2m_mou_8	
0.00 1187 0.00 std_og	NaN std_og_t2m_mou_6	1361.94	2202.03	
0.00 1187 0.00 std_og 77 0.00	NaN std_og_t2m_mou_6 g_t2m_mou_9 \ NaN	1361.94 std_og_t2m_mou_7 0.00	2202.03 std_og_t2m_mou_8 0.00	
0.00 1187 0.00 std_og 77 0.00 364	NaN std_og_t2m_mou_6 g_t2m_mou_9 \ NaN	1361.94 std_og_t2m_mou_7	2202.03 std_og_t2m_mou_8	
0.00 1187 0.00 std_og 77 0.00	NaN std_og_t2m_mou_6 g_t2m_mou_9 \ NaN	1361.94 std_og_t2m_mou_7 0.00	2202.03 std_og_t2m_mou_8 0.00 321.41	
0.00 1187 0.00 std_og 77 0.00 364 302.91	NaN std_og_t2m_mou_6 g_t2m_mou_9 \ NaN NaN	1361.94 std_og_t2m_mou_7 0.00 722.01	2202.03 std_og_t2m_mou_8 0.00	

934	Na	aN	0.00		0.00
0.00					
1187	Na	aN	0.00		1.13
0.00					
std_og	_t2f_mou_	_6 std_og_t2	2f_mou_7 s	td_og_t2	f_mou_8
std og t2f m	ou 9 \				
77		aΝ	6.35		40.09
0.0					
364	N:	aΝ	0.00		0.00
0.0	140	a.•	0.00		0.00
423	NI.	϶N	0.00		0.61
	IVe	aiv	0.00		0.01
0.0			0.00		0.00
934	Na	϶N	0.00		0.00
0.0					
1187	Na	϶N	0.00		0.00
0.0					
std oa	t2c mou	6 std_og_t2	2c mou 7 s	td oa t2	c mou 8
std og t2c m				_ 3_	
77		aΝ	0.0		0.0
0.0	140	A11	0.10		0.0
364	NI.	϶N	0.0		0.0
0.0	IVO	ZIV	0.0		0.0
	NI.	- NI	0.0		0 0
423	Na	eΝ	0.0		0.0
0.0					
934	Na	aN	0.0		0.0
0.0					
1187	Na	aΝ	0.0		0.0
0.0					
std og	mou 6	std og mou 7	std og mo	u 8 std	og mou 9
isd_og_mou_6		_ 3			
77	NaN	6.35	40	.09	0.00
NaN	Hait	0133	10	.03	0100
364	NaN	1126.73	512	0.1	810.18
	Ivaiv	1120.73	312	.91	010.10
NaN	NI - NI	0.00	0	0.0	0.00
423	NaN	0.00	0	.86	0.00
NaN			_		
934	NaN	14.16	0	.00	0.00
NaN					
1187	NaN	1361.94	2203	. 16	0.00
NaN					
isd oa	mou 7	isd og mou 8	isd og mo	u 9 spl	og mou 6
spl og mou 7				<u> </u>	_0904_0
77	2.93	28.04	2	. 25	NaN
0.00	2.93	20.04	3	. 23	IVAIN
	0.00	0.00	0	00	NI - NI
364	0.00	0.00	U	.00	NaN
45.14					

423	10.03	0.00	0.01	NaN	
0.00					
934	20.13	8.41	0.00	NaN	
0.00					
1187	0.00	0.00	0.00	NaN	
3.34					
	anl an mau 0 a	m1 am ma 0 am a.	+hawa 6 aw 4	-th7	
00 0+		pl_og_mou_9 og_o	thers_b og_c	others_/	
77	hers_8 \ 7.58	0.00	NaN	0.0	
0.0	7.50	0.00	IVAIN	0.0	
364	13.84	37.74	NaN	0.0	
0.0	13101	37171	Han	010	
423	0.00	0.00	NaN	0.0	
0.0					
934	0.00	0.00	NaN	0.0	
0.0					
1187	1.78	0.00	NaN	0.0	
0.0					
	og othors O to	+-1	ol og mau 7	+o+ol og mau 0 \	
77	og_others_9 to 0.0	tal_og_mou_6 tot 0.0	al_og_mou_7 76.61	total_og_mou_8 \	
364	0.0	0.0	1301.03	1128.43	
423	0.0	0.0	10.03	1.45	
934	0.0	0.0	51.38	101.21	
1187	0.0	0.0	1377.84	2282.43	
	total_og_mou_9	loc_ic_t2t_mou_6	loc_ic_t2t_	_mou_7	
	c_t2t_mou_8 \				
77	67.24	NaN		79.46	
191.2		NoN		7 41	
364 10.23	1403.38	NaN		7.41	
423	0.34	NaN		0.00	
0.00	0.54	Nan		0.00	
934	51.34	NaN		0.39	
20.09		. Ton		0.55	
1187	0.00	NaN		19.34	
56.38					
loc i	loc_ic_t2t_mou_9 c t2m mou 8 \	9 loc_ic_t2m_mou	_6 loc_ic_t2	2m_mou_7	
77 _	5.20	6 N	aN	43.31	
94.18					
364	17.40	6 N	aN	69.39	
93.48		0	- NI	0.00	
423 0.00	0.00	U N	aN	0.00	
1.1 [.][.]					
	12 10	Ω ΝΙ	a N	1 52	
934 51.16	12.19	9 N	aN	4.53	

1187 0.0 16.31	0 NaN	28.19	
<pre>loc_ic_t2m_mou_ loc ic t2f mou 8 \</pre>	9 loc_ic_t2f_mou_6	loc_ic_t2f_mou_7	
77 16.3	9 NaN	2.03	
0.00 364 44.8	9 NaN	0.00	
0.83 423 0.0	0 NaN	0.00	
0.00 934 59.8	3 NaN	7.80	
17.08 1187 0.0 0.00	0 NaN	0.00	
loc_ic_t2f_mou_ 77	8		_mou_8 \ 285.43 104.54 0.00 88.34 72.69
std_ic_t2t_mou_8 \		d_ic_t2t_mou_7	
77 37.44 0.00	NaN	8.00	
364 62.36	NaN	5.81	
10.09 423 0.00	NaN	0.00	
0.00		0.00	
934 77.16 0.00	NaN	0.00	
1187 0.00 149.81	NaN	125.44	
std_ic_t2t_mou_ std ic t2m mou 8 \	9 std_ic_t2m_mou_6	std_ic_t2m_mou_7	
77 0.00	0 NaN	0.00	
364 22.3	6 NaN	37.94	
86.63 423 0.0	0 NaN	0.00	
0.00 934 0.0	0 NaN	0.00	
0.00 1187 0.0 17.06	0 NaN	9.84	
std_ic_t2m_mou_	9 std_ic_t2f_mou_6	std_ic_t2f_mou_7	

std_ic_t2f_mc		N - N	0.0
77	0.00	NaN	0.0
0.00	24 40	NaN	0.0
364	34.49	NaN	0.0
0.00	0.00	NoN	0.0
423	0.00	NaN	0.0
0.36 934	0.00	NaN	0.0
0.00	0.00	ivaiv	0.0
1187	0.00	NaN	0.0
0.00	0.00	Ivaiv	0.0
0.00			
std ic	t2f mou 9 sto	d ic t2o mou 6 std	ic t2o mou 7
std ic t2o mo		* ·_ · · · · · · · · · · · · · · · · ·	
77	15.93	NaN	0.0
0.0			
364	0.00	NaN	0.0
0.0			
423	0.00	NaN	0.0
0.0			
934	0.00	NaN	0.0
0.0			
1187	0.00	NaN	0.0
0.0			
			7
			nou_7 std_ic_mou_8 \
77	0.0	NaN	8.00 0.00
364	0.0		13.76 96.73
423 934	0.0	NaN	0.00 0.36
934 1187	0.0 0.0	NaN NaN 13	0.00
110/	0.0	ivalv 13	33.29 100.66
std ic	mou 9 total	ic mou 6 total ic m	nou 7 total ic mou 8 \
77			35.38 289.33
364	56.86		35.14 219.59
423	0.00	0.0	8.31 0.36
934	0.00		14.69 100.94
1187	0.00		32.84 239.58
		ic_mou_6 spl_ic_mou	_7 spl_ic_mou_8
spl_ic_mou_9			
77	53.38	NaN 0	0.0
0.0			
364	129.19	NaN G	0.0
0.0	0.00		
423	0.00	NaN (	0.0
0.0	70.00	Al - Al	2.0
934	78.99	NaN (	0.0
0.0			
1187	0.00	NaN (	0.0

0.0					
	isd_ic_mou_6 i	sd_ic_mou_7	isd_ic_mou_	8 isd_ic_mou_9	
	ners_6 \	2.50	0.5		
77 N - N	NaN	2.56	0.50	0.00	
NaN	NI - NI	64.56	10.0	1 0.00	
364	NaN	64.56	18.3	9.96	
NaN	NoN	0 21	0.00	0 00	
423 NaN	NaN	8.31	0.00	0.00	
934	NaN	1.96	12.59	9 1.83	
NaN	Ivaiv	1.90	12.5	9 1.03	
1187	NaN	0.00	0.0	0.00	
NaN	IVAIN	0.00	0.00	0.00	
Nan					
	ic others 7 ic	others 8	ic others 9	total rech num 6	\
77	0.0	3.39	0.0	4	,
364	0.0	0.00	0.0	4	
423	0.0	0.00	0.0	4	
934	0.0	0.00	0.0	3	
1187	0.0	0.00	0.0	2	
	total_rech_num_	7 total_re	ch_num_8 tota	al_rech_num_9	
	_rech_amt_6 \	_		_	
77		5	3	3	
0	-	2	2.4	20	
364	<u></u>	2	24	20	
0		4	2	2	
423		4	3	3	
252 934		4	9	4	
934		4	9	4	
1187	2	0	24	6	
0	2		47	U	
5					
	total_rech_amt_	7 total re	ch_amt_8 tota	al_rech_amt 9	
max_re	ech_amt_6 $\overline{\ }$	<del>_</del>			
77 _	115	4	750	0	
0					
364	97	0	1104	1214	
0					
423	59	1	0	382	
252					
934	130	2	150	108	
0					
1187	88	3	1160	0	
0					
	may roch amt 7	may rach a	m+ 0 may rac	h am+ 0	
lact o	_max_rech_amt_7 day_rch_amt_6 \		mr_o max_reci	II_allit_9	
cast_C	aay_r cii_aiiit_0 '\				

77	1000		750	0	
0 364	154		154	250	
0	134		134	230	
423	339		0	252	
252 934	550		150	54	
0	330		130	54	
1187	150		250	0	
0					
	last_day_rch_a	mt_7 last_	day_rch_amt_8	last_day_rc	h_amt_9
vol_2 77	g_mb_6 \	0	750		0
0.0					
364		50	50		Θ
0.0 423		0	Θ		0
3.3					
934 0.0		0	150		0
1187		30	0		0
0.0					
	vol_2g_mb_7 v	ol_2g_mb_8	vol_2g_mb_9	vol_3g_mb_6	vol_3g_mb_7
\	06.40	0.00	0.00		0.00
77	96.48	0.00	0.00	0.00	0.00
364	565.78	2108.66	0.00	0.00	0.00
423	38.45	0.00	4.52	669.36	837.18
934	0.31	38.77	78.66	0.00	1045.79
1187	0.00	0.00	0.00	0.00	0.00
1107	0.00	0.00	0.00	0.00	0.00
	vol_3g_mb_8 v	ol 3a mh 0	monthly 2a 6	monthly 2a	7
month	ly_2g_8 \		morrency_zg_o	monthey_2g_	, ,
77	0.00	0.00	0		1
0 364	0.00	0.00	Θ		1
1					
423	0.00	423.59	0		0
0 934	245.91	471.48	0		0
0					
1187 0	0.00	0.00	0		0
U					

	monthly_2g_9	sachet_2g_6	sachet_2g_7	sachet_2g_8	sachet_2g_9
\ 77	0	Θ	0	Θ	0
364	0	0	0	2	0
423	0	0	0	0	0
934	0	0	0	0	0
1187	0	0	0	0	0
sache	monthly_3g_6 t 3g 6 \	monthly_3g_7	monthly_3g_	_8 monthly_3g	_9
77	0	0		0	0
0 364	0	0		0	0
0	0	0		0	U
423	1	1		0	1
0	1	_		0	-
934	0	1		1	0
0		_		_	
1187 0	Θ	0		0	Θ
41 v		sachet_3g_8	sachet_3g_9	aon aug_vbc	_3g
jul_v 77	bc_3g \ 0	0	0	1894 0	.00
0.00	•	•	_		
364	0	1	0	424 0	.00
0.00					
423 266.9	0	0	0	945 73	.55
934	9	2	1	490 188	.83
215.0					
1187	0	0	0	737 0	.00
0.00					
	iun uho 2a o	son who day aw	a roch amt 6	7	
77 364 423 934 1187	jun_vbc_3g s 0.00 0.00 63.04 0.00 0.00	sep_vbc_3g av 0.00 0.00 0.00 24.18 0.00	g_rech_amt_6_ 577. 485. 421. 651. 441.	. 0 . 0 . 5 . 0	
		ords for which l_mou_6.index		(6) are null	

```
# Again cheking percent of missing values in columns
df missing columns =
(round(((df.isnull().sum()/len(df.index))*100),2).to frame('null')).so
rt values('null', ascending=False)
df missing columns
                   null
loc ic t2f mou 7
                   0.12
isd ic mou 7
                   0.12
loc_og_t2f_mou_7
                   0.12
loc_og_t2c_mou_7
                   0.12
loc og mou 7
                   0.12
                    . . .
spl og mou 6
                   0.00
                   0.00
spl og mou 8
spl og mou 9
                   0.00
og others 6
                   0.00
avg rech amt 6 7 0.00
[178 rows x 1 columns]
# Listing the columns of MOU Jul(7)
print(((df missing columns[df missing columns['null'] ==
0.12]).index).to list())
['loc_ic_t2f_mou_7', 'isd_ic_mou_7', 'loc_og_t2f_mou_7',
'loc_og_t2c_mou_7', 'loc_og_mou_7', 'std_og_t2t_mou_7',
'std_og_t2f_mou_7', 'std_og_t2c_mou_7', 'std_og_mou_7', 'ic_others_7',
'isd og mou_7', 'spl_og_mou_7', 'loc_og_t2t_mou_7', 'og_others_7',
'spl_ic_mou_7', 'loc_ic_t2t_mou_7', 'std_ic_mou_7'
'loc ic t2m mou 7', 'std ic t2o mou 7', 'std ic t2f mou 7',
'loc_ic_mou_7', 'std_ic_t2t_mou_7', 'loc_og_t2m_mou_7'
'std og t2m mou 7', 'std ic t2m mou 7', 'roam ic mou 7',
'onnet mou 7', 'roam og mou 7', 'offnet mou 7']
# Creating a dataframe with the condition, in which MOU for Jul(7) are
null
df null mou 7 = df[(df['loc og t2m mou 7'].isnull()) &
(df['loc ic t2f mou 7'].isnull()) & (df['roam og mou 7'].isnull()) &
(df['std_ic_t2m_mou_7'].isnull()) &
  (df['loc og t2t mou 7'].isnull()) &
(df['std ic t2t mou 7'].isnull()) & (df['loc og t2f mou 7'].isnull())
& (df['loc ic mou 7'].isnull()) &
  (df['loc og t2c mou 7'].isnull()) & (df['loc og mou 7'].isnull()) &
(df['std og t2t mou 7'].isnull()) & (df['roam ic mou 7'].isnull()) &
  (df['loc ic t2m mou 7'].isnull()) &
(df['std og t2m mou 7'].isnull()) & (df['loc ic t2t mou 7'].isnull())
& (df['std og t2f mou 7'].isnull()) &
  (df['std_og_t2c_mou_7'].isnull()) & (df['og_others_7'].isnull()) &
(df['std og mou 7'].isnull()) & (df['spl og mou 7'].isnull()) &
```

```
(df['std ic t2f mou 7'].isnull()) & (df['isd og mou 7'].isnull()) &
(df['std ic mou 7'].isnull()) & (df['offnet mou 7'].isnull()) &
  (df['isd ic mou 7'].isnull()) & (df['ic others 7'].isnull()) &
(df['std ic t2o mou 7'].isnull()) & (df['onnet mou 7'].isnull()) &
  (df['spl ic mou 7'].isnull())]
df null mou 7.head()
       mobile number loc og t2o mou std og t2o mou
loc ic t2o mou \
          7001238202
5616
                                  0.0
                                                   0.0
                                                                    0.0
9451
          7001477649
                                  0.0
                                                   0.0
                                                                    0.0
                                                   0.0
                                                                    0.0
9955
          7001658068
                                  0.0
                                                   0.0
                                                                    0.0
10724
          7001391499
                                  0.0
                                  0.0
                                                   0.0
                                                                    0.0
12107
          7000131738
         arpu 6
                   arpu 7
                            arpu 8
                                      arpu 9
                                               onnet mou 6
                                                            onnet mou 7
5616
        760.815
                 531.088
                           992.818
                                    1144.676
                                                    324.91
                                                                     NaN
9451
       1129.566
                    0.000
                           128.252
                                                                     NaN
                                     802.648
                                                     11.89
9955
        925,028
                  189.000
                           789.761
                                     445.707
                                                     46.39
                                                                     NaN
10724
                                                                     NaN
        894.818
                  85.000
                           207.040
                                     363.314
                                                    117.21
12107
       1803.475
                    0.000
                           0.600
                                      25,243
                                                   1742.61
                                                                     NaN
       onnet mou 8
                    onnet mou 9 offnet mou 6
                                                 offnet mou 7
offnet mou 8 \
5616
            386.13
                         1180.29
                                         350.29
                                                           NaN
399.64
9451
              1.46
                           33.89
                                         259.18
                                                           NaN
26.21
9955
             43.39
                           56.61
                                         333.78
                                                           NaN
196.53
10724
             97.01
                           35.43
                                         119.79
                                                           NaN
12.79
12107
              0.00
                            0.00
                                         278.79
                                                           NaN
14.29
       offnet mou 9
                      roam ic mou 6
                                      roam ic mou 7
                                                     roam ic mou 8 \
                             463.63
5616
             887.76
                                                NaN
                                                             221.46
             241.18
                               9.98
9451
                                                NaN
                                                               1.73
9955
             144.73
                               0.00
                                                NaN
                                                               0.00
```

10724					
roam_ic_mou_9					
5616	12107	4.50	0.00	Ivaiv	0.00
loc og t2t mou 8         0.0         145.91         NaN           243.43         9451         0.0         6.73         NaN           1.46         9955         0.0         46.39         NaN           99.55         0.0         46.39         NaN           97.01         0.0         115.08         NaN           97.01         0.0         96.08         NaN           0.00         0         0         0           10c og t2t mou 9         10c og t2m mou 6         10c og t2m mou 7           10c og t2t mou 6         10c og t2t mou 7         10c og t2t mou 6           10c og t2t mou 8         NaN         113         NaN           955         125 mou 8         0         0         NaN           0.00	9451 9955 10724	0.0 0.0 0.0 0.0	505.71 5.66 0.00 0.00	NaN NaN NaN NaN	75.93 2.46 0.00 0.00
loc og t2t mou 8         0.0         145.91         NaN           243.43         9451         0.0         6.73         NaN           1.46         9955         0.0         46.39         NaN           99.55         0.0         46.39         NaN           97.01         0.0         115.08         NaN           97.01         0.0         96.08         NaN           0.00         0         0         0           10c og t2t mou 9         10c og t2m mou 6         10c og t2m mou 7           10c og t2t mou 6         10c og t2t mou 7         10c og t2t mou 6           10c og t2t mou 8         NaN         113         NaN           955         125 mou 8         0         0         NaN           0.00					
5616			c_og_t2t_mou_6 lo	oc_og_t2t_mou_7	
243.43 9451					
9451			145.91	NaN	
1.46 9955					
9955		0.0	6.73	NaN	
43.39 10724					
10724		0.0	46.39	NaN	
97.01 12107					
12107		0.0	115.08	NaN	
0.00         loc_og_t2t_mou_9         loc_og_t2m_mou_6         loc_og_t2m_mou_7           10c_og_t2m_mou_8         \ 5616         1108.38         0.85         NaN           184.78         9451         20.84         171.46         NaN           20.54         9955         56.61         227.91         NaN           163.68         10724         34.98         86.39         NaN           6.59         12107         0.00         64.98         NaN           0.86         loc_og_t2m_mou_9         loc_og_t2f_mou_6         loc_og_t2f_mou_7           1oc_og_t2f_mou_8         \         300.19         1.13         NaN           7.94         9451         148.88         0.00         NaN           0.00         9955         121.54         104.69         NaN           28.96         10724         55.44         17.18         NaN           6.19         12107         0.00         0.00         NaN           0.00         0.00         NaN					
loc_og_t2t_mou_9		0.0	96.08	NaN	
loc_og_t2m_mou_8       0.85       NaN         184.78       108.38       0.85       NaN         9451       20.84       171.46       NaN         20.54       9955       56.61       227.91       NaN         163.68       10724       34.98       86.39       NaN         6.59       12107       0.00       64.98       NaN         0.86       NaN       NaN       NaN         5616       300.19       1.13       NaN         7.94       9451       148.88       0.00       NaN         0.00       9955       121.54       104.69       NaN         28.96       10724       55.44       17.18       NaN         6.19       12107       0.00       0.00       NaN         0.00       0.00       NaN       0.00	0.00				
loc_og_t2m_mou_8       0.85       NaN         184.78       108.38       0.85       NaN         9451       20.84       171.46       NaN         20.54       9955       56.61       227.91       NaN         163.68       10724       34.98       86.39       NaN         6.59       12107       0.00       64.98       NaN         0.86       NaN       NaN       NaN         5616       300.19       1.13       NaN         7.94       9451       148.88       0.00       NaN         0.00       9955       121.54       104.69       NaN         28.96       10724       55.44       17.18       NaN         6.19       12107       0.00       0.00       NaN         0.00       0.00       NaN       0.00		loc og t2t mou 9	loc og t2m mou 6	loc og t2m mou 7	
5616       1108.38       0.85       NaN         184.78       9451       20.84       171.46       NaN         20.54       9955       56.61       227.91       NaN         163.68       10724       34.98       86.39       NaN         6.59       12107       0.00       64.98       NaN         0.86       NaN         loc_og_t2m_mou_9       loc_og_t2f_mou_6       loc_og_t2f_mou_7         loc_og_t2f_mou_8       NaN         7.94       NaN         9451       148.88       0.00       NaN         0.00       9955       121.54       104.69       NaN         28.96       10724       55.44       17.18       NaN         6.19       12107       0.00       0.00       NaN         0.00	loc og				
9451 20.84 171.46 NaN 20.54 9955 56.61 227.91 NaN 163.68 10724 34.98 86.39 NaN 6.59 12107 0.00 64.98 NaN 0.86  loc_og_t2m_mou_9 loc_og_t2f_mou_6 loc_og_t2f_mou_7 loc_og_t2f_mou_8 \ 5616 300.19 1.13 NaN 7.94 9451 148.88 0.00 NaN 0.00 9955 121.54 104.69 NaN 28.96 10724 55.44 17.18 NaN 6.19 12107 0.00 0.00 NaN 0.00			0.85	NaN	
20.54 9955 56.61 227.91 NaN 163.68 10724 34.98 86.39 NaN 6.59 12107 0.00 64.98 NaN 0.86  loc_og_t2m_mou_9 loc_og_t2f_mou_6 loc_og_t2f_mou_7 loc_og_t2f_mou_8 \ 5616 300.19 1.13 NaN 7.94 9451 148.88 0.00 NaN 0.00 9955 121.54 104.69 NaN 28.96 10724 55.44 17.18 NaN 6.19 12107 0.00 0.00 NaN 0.00	184.78				
9955 56.61 227.91 NaN 163.68 10724 34.98 86.39 NaN 6.59 12107 0.00 64.98 NaN 0.86  loc_og_t2m_mou_9 loc_og_t2f_mou_6 loc_og_t2f_mou_7 loc_og_t2f_mou_8 \ 5616 300.19 1.13 NaN 7.94 9451 148.88 0.00 NaN 0.00 9955 121.54 104.69 NaN 28.96 10724 55.44 17.18 NaN 6.19 12107 0.00 0.00 NaN 0.00	9451	20.84	171.46	NaN	
163.68 10724 34.98 86.39 NaN 6.59 12107 0.00 64.98 NaN 0.86  loc_og_t2m_mou_9 loc_og_t2f_mou_6 loc_og_t2f_mou_7 loc_og_t2f_mou_8 \ 5616 300.19 1.13 NaN 7.94 9451 148.88 0.00 NaN 0.00 9955 121.54 104.69 NaN 28.96 10724 55.44 17.18 NaN 6.19 12107 0.00 0.00 NaN 0.00	20.54				
10724 34.98 86.39 NaN 6.59 12107 0.00 64.98 NaN 0.86  loc_og_t2m_mou_9 loc_og_t2f_mou_6 loc_og_t2f_mou_7 loc_og_t2f_mou_8 \ 5616 300.19 1.13 NaN 7.94 9451 148.88 0.00 NaN 0.00 9955 121.54 104.69 NaN 28.96 10724 55.44 17.18 NaN 6.19 12107 0.00 0.00 NaN 0.00	9955	56.61	227.91	NaN	
6.59 12107					
12107 0.00 64.98 NaN 0.86  loc_og_t2m_mou_9 loc_og_t2f_mou_6 loc_og_t2f_mou_7 loc_og_t2f_mou_8 \ 5616 300.19 1.13 NaN 7.94 9451 148.88 0.00 NaN 0.00 9955 121.54 104.69 NaN 28.96 10724 55.44 17.18 NaN 6.19 12107 0.00 0.00 NaN 0.00	_	34.98	86.39	NaN	
0.86  loc_og_t2m_mou_9 loc_og_t2f_mou_6 loc_og_t2f_mou_7 loc_og_t2f_mou_8 \ 5616 300.19 1.13 NaN 7.94 9451 148.88 0.00 NaN 0.00 9955 121.54 104.69 NaN 28.96 10724 55.44 17.18 NaN 6.19 12107 0.00 0.00 NaN 0.00					
loc_og_t2m_mou_9 loc_og_t2f_mou_6 loc_og_t2f_mou_7 loc_og_t2f_mou_8 \ 5616		0.00	64.98	NaN	
loc_og_t2f_mou_8       \         5616       300.19       1.13       NaN         7.94       9451       148.88       0.00       NaN         0.00       9955       121.54       104.69       NaN         28.96       10724       55.44       17.18       NaN         6.19       12107       0.00       0.00       NaN         0.00       0.00       NaN	0.86				
loc_og_t2f_mou_8       \         5616       300.19       1.13       NaN         7.94       9451       148.88       0.00       NaN         0.00       9955       121.54       104.69       NaN         28.96       10724       55.44       17.18       NaN         6.19       12107       0.00       0.00       NaN         0.00       0.00       NaN		1	1	1	
5616       300.19       1.13       NaN         7.94       9451       148.88       0.00       NaN         0.00       9955       121.54       104.69       NaN         28.96       10724       55.44       17.18       NaN         6.19       12107       0.00       0.00       NaN         0.00       0.00       NaN	100.00		LOC_OG_TZT_MOU_6	loc_og_tzt_mou_/	
7.94 9451 148.88 0.00 NaN 0.00 9955 121.54 104.69 NaN 28.96 10724 55.44 17.18 NaN 6.19 12107 0.00 0.00 NaN			1 10	NaN	
9451 148.88 0.00 NaN 0.00 9955 121.54 104.69 NaN 28.96 10724 55.44 17.18 NaN 6.19 12107 0.00 0.00 NaN		300.19	1.13	IValv	
0.00         9955       121.54       104.69       NaN         28.96         10724       55.44       17.18       NaN         6.19         12107       0.00       0.00       NaN         0.00		1/10 00	0.00	NaM	
9955 121.54 104.69 NaN 28.96 10724 55.44 17.18 NaN 6.19 12107 0.00 0.00 NaN 0.00		140.00	0.00	IValv	
28.96 10724 55.44 17.18 NaN 6.19 12107 0.00 0.00 NaN 0.00		121 54	10/ 60	NaM	
10724 55.44 17.18 NaN 6.19 12107 0.00 0.00 NaN 0.00		121.34	104.09	IVAIV	
6.19 12107 0.00 0.00 NaN 0.00		55 11	17 10	NaM	
12107 0.00 0.00 NaN 0.00		33.44	17.10	IVAIV	
0.00		0.00	0.00	NaN	
		0100	0.00	Nan	
loc_og_t2f_mou_9 loc_og_t2c_mou_6 loc_og_t2c_mou_7	0.00				
		loc og t2f mou 9	loc og t2c mou 6	loc og t2c mou 7	

loc_og_ 5616	_t2c_mou_8 \ 67.11	0.00	NaN
12.51 9451	0.00	0.00	NaN
0.00 9955	21.04	0.00	NaN
0.00 10724	28.08	0.00	NaN
0.00 12107	0.00	50.03	NaN
13.43			
5616 9451 9955 10724 12107	loc_og_t2c_mou_9 18.89 0.00 0.00 0.05 4.50	loc_og_mou_6 loc_ 147.89 178.19 379.01 218.66 161.06	og_mou_7 loc_og_mou_8 \ NaN 436.16 NaN 22.01 NaN 236.04 NaN 109.81 NaN 0.86
std oa	loc_og_mou_9 std t2t mou 8 \	_og_t2t_mou_6 std_	og_t2t_mou_7
5616 17.06	1475.69	0.96	NaN
9451 0.00	169.73	5.16	NaN
9955 0.00	199.21	0.00	NaN
10724 0.00	118.51	2.13	NaN
12107 0.00	0.00	1646.53	NaN
		std_og_t2m_mou_6	std_og_t2m_mou_7
5616 144.04	_t2m_mou_8 \ 69.51	15.91	NaN
9451 0.00	13.05	0.00	NaN
9955 0.00	0.00	0.00	NaN
10724 0.00	0.45	2.43	NaN
12107 0.00	0.00	140.16	NaN
std og	std_og_t2m_mou_9 _t2f_mou_8 \	std_og_t2f_mou_6	std_og_t2f_mou_7
5616 0.0	490.61	0.00	NaN
9451	0.00	0.00	NaN

0.0				
0.0				
9955	1.26	1.16	NaN	J
2.9 10724	7.18	6.09	NaN	ı
0.0	7.10	0.09	IVal	V
12107	0.00	1.26	NaM	I
0.0				
	atd as t2f ma 0	atd as the man 6	atal as t2a ma	,
std on	<pre>std_og_t2f_mou_9 t2c mou 8 \</pre>	std_og_t2c_mou_6	std_og_t2c_mou_7	
5616	13.33	0.0	NaN	J
0.0				
9451	0.00	0.0	NaN	I
0.0 9955	0.00	0.0	NaN	ı
0.0	0.00	0.0	ivai	V .
10724	1.28	0.0	NaM	I
0.0				
12107	0.00	0.0	NaN	J
0.0				
	std_og_t2c_mou_9	std_og_mou_6 std	d_og_mou_7 std_og	g_mou_8 \
5616	0.0	16.88	NaN	$\overline{1}61.\overline{1}1$
9451 9955	0.0	5.16	NaN	0.00
10724	0.0 0.0	1.16 10.66	NaN NaN	2.90 0.00
				0.00
12107	0.0	1787.96	NaN	0.00
12107				
	std_og_mou_9 isd	1787.96 _og_mou_6 isd_og_		
isd_og	std_og_mou_9 isd _mou_9 \	_og_mou_6 isd_og_	_mou_7 isd_og_mou	ı_8
	std_og_mou_9 isd		_mou_7 isd_og_mou	
isd_og_ 5616 0.00 9451	std_og_mou_9 isd _mou_9 \	_og_mou_6 isd_og_	_mou_7 isd_og_mou NaN 0.	ı_8
isd_og_ 5616 0.00 9451 92.29	std_og_mou_9 isd _mou_9 \ 573.46 13.05	_og_mou_6 isd_og_ 0.00 74.91	_mou_7 isd_og_mou NaN 0. NaN 4.	u_8 .00 .74
isd_og_ 5616 0.00 9451 92.29 9955	std_og_mou_9 isd _mou_9 \ 573.46	_og_mou_6 isd_og_ 0.00	_mou_7 isd_og_mou NaN 0.	u_8 .00 .74
isd_og_ 5616 0.00 9451 92.29	std_og_mou_9 isd _mou_9 \ 573.46 13.05	_og_mou_6 isd_og_ 0.00 74.91	_mou_7 isd_og_mou NaN 0. NaN 4. NaN 31.	u_8 .00 .74
isd_og_ 5616 0.00 9451 92.29 9955 33.69 10724 2.18	std_og_mou_9 isd _mou_9 \ 573.46 13.05 1.26 8.91	_og_mou_6 isd_og_ 0.00 74.91 53.14 16.86	_mou_7 isd_og_mou NaN 0. NaN 4. NaN 31.	u_8 .00 .74 .06 .21
isd_og_ 5616 0.00 9451 92.29 9955 33.69 10724 2.18 12107	std_og_mou_9 isd _mou_9 \ 573.46 13.05 1.26	_og_mou_6 isd_og_ 0.00 74.91 53.14	_mou_7 isd_og_mou NaN 0. NaN 4. NaN 31.	u_8 00 .74 .06
isd_og_ 5616 0.00 9451 92.29 9955 33.69 10724 2.18	std_og_mou_9 isd _mou_9 \ 573.46 13.05 1.26 8.91	_og_mou_6 isd_og_ 0.00 74.91 53.14 16.86	_mou_7 isd_og_mou NaN 0. NaN 4. NaN 31.	u_8 .00 .74 .06 .21
isd_og_ 5616 0.00 9451 92.29 9955 33.69 10724 2.18 12107	std_og_mou_9 isd _mou_9 \ 573.46 13.05 1.26 8.91 0.00	_og_mou_6 isd_og_ 0.00 74.91 53.14 16.86	_mou_7 isd_og_mou NaN 0. NaN 4. NaN 31. NaN 6.	u_8 .00 .74 .06 .21
isd_og_ 5616 0.00 9451 92.29 9955 33.69 10724 2.18 12107 0.00	std_og_mou_9 isd _mou_9 \ 573.46 13.05 1.26 8.91 0.00 spl_og_mou_6 splers_6 \	_og_mou_6 isd_og_ 0.00 74.91 53.14 16.86 0.00	_mou_7 isd_og_mou NaN 0 NaN 4 NaN 31 NaN 6 NaN 0 _mou_8 spl_og_mou	u_8 .00 .74 .06 .21 .00
isd_og_ 5616 0.00 9451 92.29 9955 33.69 10724 2.18 12107 0.00	std_og_mou_9 isd _mou_9 \ 573.46 13.05 1.26 8.91 0.00	0.00 74.91 53.14 16.86 0.00	_mou_7 isd_og_mou NaN 0. NaN 4. NaN 31. NaN 6.	u_8 .00 .74 .06 .21 .00
isd_og_ 5616 0.00 9451 92.29 9955 33.69 10724 2.18 12107 0.00 og_othe 5616 0.00	std_og_mou_9 isd _mou_9 \ 573.46 13.05 1.26 8.91 0.00 spl_og_mou_6 splers_6 \ 4.71	0.00 74.91 53.14 16.86 0.00 NaN	_mou_7 isd_og_mou NaN	u_8 00 74 06 21 00 u_9
isd_og_ 5616 0.00 9451 92.29 9955 33.69 10724 2.18 12107 0.00	std_og_mou_9 isd _mou_9 \ 573.46 13.05 1.26 8.91 0.00 spl_og_mou_6 splers_6 \	_og_mou_6 isd_og_ 0.00 74.91 53.14 16.86 0.00	_mou_7 isd_og_mou NaN	u_8 .00 .74 .06 .21 .00
isd_og_5616 0.00 9451 92.29 9955 33.69 10724 2.18 12107 0.00  og_othe 5616 0.00 9451 0.00 9955	std_og_mou_9 isd _mou_9 \ 573.46 13.05 1.26 8.91 0.00 spl_og_mou_6 splers_6 \ 4.71	0.00 74.91 53.14 16.86 0.00 NaN	_mou_7 isd_og_mou NaN	u_8 00 74 06 21 00 u_9
isd_og_5616 0.00 9451 92.29 9955 33.69 10724 2.18 12107 0.00 og_othe 5616 0.00 9451 0.00	std_og_mou_9 isd _mou_9 \ 573.46 13.05 1.26 8.91 0.00 spl_og_mou_6 spl ers_6 \ 4.71 7.13	_og_mou_6 isd_og_ 0.00 74.91 53.14 16.86 0.00 _og_mou_7 spl_og_ NaN NaN	_mou_7 isd_og_mou NaN	u_8 .00 .74 .06 .21 .00 u_9 .89

0.00	70.01			
12107	72.61	NaN	13.43	4.50
1.76				
0.0	g others 7 og ot	thers 8 og otl	ners 9 t	otal og mou 6
total_og			.5.5_5	
5616	ou, NaN	0.0	0.0	169.49
0.0				
9451	NaN	0.0	0.0	265.41
0.0				
9955	NaN	0.0	0.0	433.33
0.0	N	0.0	0 0	246 12
10724	NaN	0.0	0.0	246.19
0.0	NaN	0.0	0.0	2022 41
12107 0.0	NaN	0.0	0.0	2023.41
0.0				
to	otal_og_mou_8 to	otal_og_mou_9	loc_ic_t	:2t_mou_6
	2t_mou_7 \			
561 <del>6</del> –	609.84	2068.06		78.76
NaN				
9451	26.76	276.16		17.24
NaN	270.01	224 10		00.00
9955	270.01	234.18		80.98
NaN 10724	116 02	120 66		007 04
10724 NaN	116.03	129.66		887.04
12107	14.29	4.50		65.76
NaN	11123	1150		03170
	oc_ic_t2t_mou_8	loc_ic_t2t_mo	u_9 loc_	_ic_t2m_mou_6
	2m_mou_7 \	550	0.4	1 26
5616	233.66	558	. 84	1.36
NaN 9451	0.60	36	. 69	130.09
NaN	0.00	30	. 09	130.09
9955	32.69	112	. 14	201.38
NaN				
10724	200.51	408	. 66	104.18
NaN				
12107	1.73	5	. 88	92.18
NaN				
1,	oc ic t2m mou 8	loc ic t2m mou	1 0 100	ic t2f mou 6
loc ic ta		.00_10_12   _   0	_9	_10_121_1110u_0
5616	11.53	75	.31	6.61
NaN	11.33	,,,		0.01
9451	16.54	110	. 19	25.46
NaN				
9955	169.24	155	. 58	41.68

MaN				
NaN 10724	22.24	76.39	16.74	
NaN	22121	70133	1017	
12107	5.59	2.75	0.00	
NaN				
	loc_ic_t2f_mou_8	loc_ic_t2f_mou_9	loc_ic_mou_6 lo	c_ic_mou_7
\ 5016	0.00	21 01	06.74	N - N
5616	0.00	31.81	86.74	NaN
9451	8.76	40.24	172.81	NaN
9955	25.68	12.33	324.04	NaN
10724	1.61	28.18	1007.98	NaN
12107	0.00	0.00	157.94	NaN
12107	0.00	0.00	237.13.	11011
,	loc_ic_mou_8 loc	_ic_mou_9 std_ic_	t2t_mou_6 std_ic	_t2t_mou_7
\ 5616	245.19	665.98	0.00	NaN
2010	245.19	005.90	0.00	Ivaiv
9451	25.91	187.14	1.50	NaN
9955	227.63	280.06	0.00	NaN
10724	224.38	513.24	0.00	NaN
12107	7.33	8.63	103.66	NaN
12107	7.55	0.03	105.00	IVAIV
	std_ic_t2t_mou_8	std_ic_t2t_mou_9	std_ic_t2m_mou_6	
	_t2m_mou_7 \	42.20	21 70	
5616	12.13	42.39	21.76	
NaN 9451	0.00	0.00	0.41	
NaN	0100	0100	0173	
9955	0.00	0.00	0.98	
NaN				
10724	0.00	0.00	5.94	
NaN				
12107	0.00	0.00	3.01	
NaN				
	std ic t2m mou 8	std ic t2m mou 9	std ic t2f mou 6	
std ic	t2f mou 7 \	5td_1tt2m_mod_5	Jtd_IC_tZ1_mod_c	
5616	110.99	263.98	0.0	
NaN				
9451	0.00	12.29	0.0	
NaN				

9955	2.13	2.58	0.0	
NaN 10724	0.00	4.88	0.0	
NaN 12107	0.00	0.00	0.0	
NaN	0.00	0.00	0.0	
		std_ic_t2f_mou_9 st	td_ic_t2o_mou_6	
std_ic_ 5616	_t2o_mou_7 \ 0.00	6.43	0.0	
NaN 9451				
NaN	0.00	4.48	0.0	
9955 NaN	0.23	0.00	0.0	
10724	10.03	1.26	0.0	
NaN 12107	0.00	0.00	0.0	
NaN				
\	std_ic_t2o_mou_8	std_ic_t2o_mou_9 st	td_ic_mou_6 std_	ic_mou_7
5616	0.0	0.0	21.76	NaN
9451	0.0	0.0	1.91	NaN
9955	0.0	0.0	0.98	NaN
10724	0.0	0.0	5.94	NaN
12107	0.0	0.0	106.68	NaN
5616	std_ic_mou_8 std_ 123.13		mou_6 total_ic_m 89.81	_
9451	0.00	16.78	17.33	0.0
9955 10724	2.36 10.03		32.33 40.54	0.0
12107	0.00		65.03	0.0
			c_mou_6 spl_ic_m	_
5616 9451	397.13 43.44	1020.16 307.43	0.00 0.00	NaN NaN
9955	506.94	526.54 642.33	0.00	NaN NaN
10724 12107	342.78 7.33	8.63	0.14 0.00	NaN
	spl_ic_mou_8 spl	_ic_mou_9 isd_ic_mou	u_6 isd_ic_mou_7	
isd_ic_ 5616	· · ·		.29 NaN	
3010	0.00	0.15	125 Naiv	

28.79				
9451	0.00	0.00	42.59	NaN
17.53 9955	0.00	0.00	7.29	NaN
173.61		0.00	7.23	IVAIV
10724	0.08	0.09	126.13	NaN
106.53		0.00	0.00	
12107 0.00	0.00	0.00	0.00	NaN
0.00				
	isd_ic_mou_9 ic_	others_6 ic_d	others_7 ic	_others_8
ic_oth			_	
5616	41.23	0.00	NaN	0.00
0.00 9451	103.49	0.00	NaN	0.00
0.00	105145	0.00	Nan	0.00
9955	229.44	0.00	NaN	103.33
14.45				
10724 5.99	116.83	0.33	NaN	1.74
12107	0.00	0.40	NaN	0.00
0.00	0.00	0.10	110.11	0.00
	total rech num 6	total rech nu	um 7 total	rech num 8
total	rech num 9 \	totat_reen_m	um_/ cocac_	.reenram_6
5616	5		7	9
13	1 /		4	4
9451 9	14		4	4
9955	6		1	4
3				
10724	8		3	3
5 12107	17		2	1
2	11		2	-
+0+01	<pre>total_rech_amt_6 rech_amt_9 \</pre>	total_rech_ar	nt_/ total_	rech_amt_8
5616	776		780	904
1591	,,,		, 00	361
9451	1206		0	223
991	1205		0	025
9955 912	1385		0	835
10724	1020		Θ	360
480				
12107	1990		0	0
30				
	max_rech_amt_6 m	ax_rech_amt_7	max_rech_a	mt_8 max_rech_amt_9
			_	<del>-</del>

\ 5616	250	Ð	330		200	289	
9451	250	9	0		130	130	
9955	350	Ð	0		300	479	
10724	500	9	Θ		130	150	
12107	250	9	0		0	30	
		_					
5616 9451 9955 10724 12107	last_day_rch_a	amt_6 last 250 250 250 250 500 110	:_day_rch_	_amt_7 l 0 0 0 0 0	.ast_day_rch	n_amt_8 \ 130 130 300 130 0	
vol 2a	last_day_rch_a mb_9 \	amt_9 vol_	2g_mb_6	vol_2g_m	nb_7 vol_20	g_mb_8	
5616		250	0.00		0.0	11.26	
83.32 9451		130	321.86		0.0	0.00	
431.85 9955		479	0.00		0.0	0.00	
0.00 10724		0	0.00		0.0	0.00	
0.00 12107		30	0.00		0.0	0.00	
0.00							
monthly		/ol_3g_mb_7	vol_3g_	_mb_8 vc	ol_3g_mb_9		
5616 0	0.0	0.0	7	79.94	668.4		
9451 1	0.0	0.0		0.00	0.0		
9955	0.0	0.0		0.00	0.0		
0 10724	0.0	0.0		0.00	0.0		
0 12107	0.0	0.0		0.00	0.0		
0				_			
sachet	monthly_2g_7 _2g_7 \	monthly_2g	_8 month	nly_2g_9	sachet_2g_	_6	
5616 0	0		1	1		0	
9451	Θ		0	1		1	

0	0	0		0	0
9955 0	0	0		0	Θ
10724	0	0		0	0
0	-	-		-	
12107	0	Θ		0	0
0					
sache	et 2a 8 sad	chet_2g_9 mon	thlv 3a 6	monthly 3	la 7
monthly_3g_8					·9_,
5616	0	0	0		0
0		_			•
9451 0	0	2	0		0
9955	0	Θ	0		0
0	Ü	· ·	ŭ		Ū
10724	0	0	0		0
0	_				
12107 0	Θ	0	0		0
U					
montl	nly_3g_9 sa	achet_3g_6 sa	chet_3g_7	sachet_3g	_8
sachet_3g_9				_	_
5616	0	0	0		0
0 576 9451	0	0	0		Θ
0 672	U	· ·	O .		U
9955	0	0	0		0
0 3107		_	_		
10724	0	0	0		0
0 2664 12107	Θ	Θ	0		0
0 219	· ·	Ŭ	ŭ		J
		_vbc_3g jun_v	bc_3g sep	_vbc_3g	
avg_rech_am <sup>2</sup> 5616	63.38	0.0	0.0	163.39	
778.0	03.30	0.0	0.0	105.55	
9451	0.00	0.0	0.0	0.00	
603.0					
9955	0.00	0.0	0.0	0.00	
692.5 10724	0.00	0.0	0.0	0.00	
510.0	0.00	010	0.0	0.00	
12107	0.00	0.0	0.0	0.00	
995.0					
<pre># Deleting df = df.drop</pre>		for which MOU	for Jul(7	) are null	

```
# Again cheking percent of missing values in columns
df missing columns =
(round(((df.isnull().sum()/len(df.index))*100),2).to frame('null')).so
rt values('null', ascending=False)
df missing columns
                  null
mobile number
                   0.0
total rech num 7
                   0.0
std ic mou 7
                   0.0
std ic mou 8
                   0.0
std_ic_mou_9
                   0.0
std og mou 7
                   0.0
std og mou 8
                   0.0
std og mou 9
                   0.0
isd og mou 6
                   0.0
avg rech amt 6 7
                   0.0
[178 rows x 1 columns]
df.shape
(27991, 178)
# Checking percentage of rows we have lost while handling the missing
values
round((1- (len(df.index)/30011)),2)
0.07
```

## Tagging the Churned Customers:

```
df['churn'] = np.where((df['total_ic_mou_9']==0) &
(df['total og mou 9']==0) & (df['vol 2g mb 9']==0) &
(df['vol 3g mb 9']==0), 1, 0)
df.head()
    mobile number loc og t2o mou std og t2o mou loc ic t2o mou
arpu 6 \
                                                                0.0
8
       7001524846
                               0.0
                                               0.0
378.721
                               0.0
                                               0.0
                                                                0.0
13
       7002191713
492.846
       7000875565
                               0.0
                                               0.0
                                                                0.0
16
430.975
17
       7000187447
                               0.0
                                               0.0
                                                                0.0
690,008
       7002124215
                               0.0
                                               0.0
                                                                0.0
514.453
```

	arpu_7		arpu_9	onnet_mou_6	onnet_mou_7	
	t_mou_8 492.223		166.787	413.69	351.03	35.08
13	205.671	593.260	322.732	501.76	108.39	534.24
16	299.869	187.894	206.490	50.51	74.01	70.61
17	18.980	25.499	257.583	1185.91	9.28	7.79
21	597.753	637.760	578.596	102.41	132.11	85.14
	onnet_m		et_mou_6	offnet_mou_7	offnet_mou_8	
8		3.46	94.66	80.63	136.48	
108. 13	24	4.81	413.31	119.28	482.46	
214. 16	3	1.34	296.29	229.74	162.76	
224. 17	558	8.51	61.64	0.00	5.54	
87.8 21		1.63	757.93	896.68	983.39	
869.	89					
	roam_ic_	_mou_6 ro	am_ic_mou_	7 roam_ic_m	ou_8 roam_ic_	mou_9
	n_og_mou					
8		0.00	0.0	0	9.00	0.00
0.00 13		23.53	144.2	4 7:	2.11 1	36.78
7.98		23.33	22	. , ,		30170
16		0.00	2.8	3 (	9.00	0.00
0.00 17		0.00	4.7	6	4.81	0.00
0.00		0.00	0.0			0.00
21 0.00		0.00	0.0	0	9.00	0.00
	roam og	mou 7 ro	am og mou	8 roam og mo	ou_9 loc_og_t	2t mou 6 \
8	r oaiii_og_	0.00			0.00	297.13
13		35.26	1.4		2.78	49.63
16		17.74	0.0		0.00	42.61
17 21		8.46 0.00	13.3 0.0		7.98	38.99 4.48
21		0.00	0.0	(	9.00	4.40
			loc_og_t2	t_mou_8 loc	_og_t2t_mou_9	
_	og_t2m_r	mou_6 \		12.40	20.12	
8		217.59		12.49	26.13	

80.96				
13	6.19	36.01	6.14	
151.13 16	65.16	67.38	26.88	
273.29	05.10	07.50	20.00	
17	0.00	0.00	36.41	
58.54 21	6 16	22.24	20.00	
91.81	6.16	23.34	29.98	
	g_t2m_mou_7 f_mou_6 \	loc_og_t2m_mou_8	loc_og_t2m_mou_9	
8	70.58	50.54	34.58	
0.00	47 20	204 46	100 24	
13 4.54	47.28	294.46	108.24	
16	145.99	128.28	201.49	
0.00				
17	0.00	0.00	9.38	
0.00 21	87.93	104.81	107.54	
0.75	07.55	104101	107154	
_		1 .06	1 .06	
	g_t2t_mou_/ c mou 6 \	loc_og_t2f_mou_8	loc_og_t2t_mou_9	
8	0.00	0.00	0.00	
0.0		0.00	0.00	
13	0.00	23.51	5.29	
0.0 16	4.48	10.26	4.66	
0.0	4.40	10.20	7.00	
17	0.00	0.00	0.00	
0.0	0.00	1 50	0.00	
21 0.0	0.00	1.58	0.00	
0.0				
	g_t2c_mou_7	loc_og_t2c_mou_8	loc_og_t2c_mou_9	loc_og_mou_6
8	0.0	7.15	0.0	378.09
13	0.0	0.49	0.0	205.31
16	0.0	0.00	0.0	315.91
17	0.0	0.00	0.0	97.54
21	0.0	0.00	0.0	07.04
21	0.0	0.00	0.0	97.04
loc_o	g_mou_7 loc	_og_mou_8 loc_og_	mou_9 std_og_t2t_	mou_6 \

8 13 16 17 21	288.18 53.48 215.64 0.00 94.09	353.99 1 205.93 2 0.00	.19.69 4 33.04	.16.56 446.41 7.89 .46.91 97.93
std_og_t2 8 13.69 13 255.36 16 22.99	eg_t2t_mou_7 em_mou_6 \ 133.43 85.98 2.58	22.58 498.23 3.23	std_og_t2t_mou_9 7.33 230.38 4.46	
17 1.55 21 665.36	0.81 125.94	0.00 61.79	504.11 131.64	
	og_t2m_mou_7 ?f_mou_6 \ 10.04	std_og_t2m_mou_8 75.69	std_og_t2m_mou_9 74.13	
13 0.0 16 0.0	52.94 64.51	156.94	96.01 13.79	
17 0.0 21 0.0	0.00 808.74	0.00 876.99	78.51 762.34	
std_og_t2 8 0.0	og_t2f_mou_7 c_mou_6 \ 0.0	0.0		
13 0.0 16 0.0 17	0.0 0.0 0.0	0.0 0.0 0.0	0.00 4.43 0.00	
0.0 21 0.0	0.0	0.0	0.00	
std_c \ 8	0.0 0.0	std_og_t2c_mou_8 0.0 0.0	std_og_t2c_mou_9 0.0 0.0	std_og_mou_6 130.26 701.78

16	0.0	0.0	0.0	30.89
17	0.0	0.0	0.0	1148.46
21	0.0	0.0	0.0	763.29
std_og_mou_7 isd_og_mou_7 \	std_og_mou_8	std_og_mou_9	isd_og_mou_6	
8 143.48 0.0	98.28	81.46	0.0	
13 138.93 0.0	655.18	326.39	0.0	
16 67.09	21.53	22.69	0.0	
0.0 17 0.81	0.00	582.63	0.0	
0.0 21 934.69	938.79	893.99	0.0	
0.0				
isd_og_mou_8 spl og mou 8 \	isd_og_mou_9	spl_og_mou_6	spl_og_mou_7	
8 0.00 10.23	0.0	0.00	0.00	
13 1.29	0.0	0.00	0.00	
4.78 16 0.00	0.0	0.00	3.26	
5.91 17 0.00	0.0	2.58	0.00	
0.00 21 0.00	0.0	0.00	0.00	
0.00				
<pre>spl_og_mou_9 og_others_9 \</pre>	og_others_6	og_others_7 o	g_others_8	
8 0.00	0.00	0.0	0.0	0.0
13 0.00	0.00	0.0	0.0	0.0
16 0.00	0.00	0.0	0.0	0.0
17 2.64	0.93	0.0	0.0	0.0
21 0.00	0.00	0.0	0.0	0.0
total_og_mou 8 508.			mou_8 total_o 71.56	g_mou_9 \ 142.18
13 907.			15.26	446.09

16 17 21	346.81 1249.53 860.34	286.01 0.81 1028.79	233.38 0.00 1068.54	255.74 631.08 1031.53
	ic_t2t_mou_6 2t_mou_9 \	loc_ic_t2t_mou_7	loc_ic_t2t_mou_8	3
8	23.84	9.84	0.33	L
13 24.98	67.88	7.58	52.58	3
16 50.23	41.33	71.44	28.89	)
17 40.91	34.54	0.00	0.00	)
21 17.99	2.48	10.19	19.54	1
	ic_t2m_mou_6 2m mou 9 \	loc_ic_t2m_mou_7	loc_ic_t2m_mou_8	3
8 17.34	57.58	13.98	15.48	3
17.34 13 104.79	142.88	18.53	195.18	3
16	226.81	149.69	150.16	5
172.86 17	47.41	2.31	0.00	)
43.86 21 113.46	118.23	74.63	129.16	5
	ic t2f mou 6	loc ic t2f mou 7	loc ic t2f mou 8	3
_	2f_mou_9 \ 0.00	0.00	0.00	
0.00				
13 8.51	4.81	0.00	7.49	
16 65.21	8.71	8.68	32.73	
17 0.71	0.00	0.00	0.00	)
21 8.41	4.61	2.84	10.39	)
		_ic_mou_7 loc_ic_	_mou_8 loc_ic_mou	<b>_</b> 9
std_ic_t2	2t_mou_6 \ 81.43	23.83	15.79 21	. 38
0.00 13	215.58	26.11 2	255.26 138	. 29
115.68 16	276.86	229.83 2	211.78 288	.31

68.79				
17	81.96	2.31	0.00 85.4	19
8.63				
21	125.33	87.68 1	59.11 139.8	38
14.06				
std	ic t2t mou 7	std ic t2t mou 8	std ic t2t mou 9	
	2m mou 6 \	5 tu_10_ t2 t5u_5	5 tu_10_t1 t6u_5	
3 3	0.58	0.10	0.00	
22.43	0.50	0.10	0.00	
	20.20	154 50	62.20	
13	38.29	154.58	62.39	
308.13				
16	78.64	6.33	16.66	
L8.68				
17	0.00	0.00	0.00	
L.28				
21	5.98	0.18	16.74	
67.69				
std	ic t2m mou 7	std ic t2m mou 8	std ic t2m mou 9	
	2f_mou_6 \			
8	4.08	0.65	13.53	
0.00	1100	0.03	13.33	
13	29.79	317.91	151.51	
9.00	29.79	517.91	151.51	
	72 00	72 02	20 50	
16	73.08	73.93	29.58	
0.51	0.00	0.00	1 62	
17	0.00	0.00	1.63	
0.00			0= 00	
21	38.23	101.74	95.98	
0.00				
		std_ic_t2f_mou_8	std_ic_t2f_mou_9	
	2o_mou_6 \			
	0.0	0.00	0.0	
9.0				
13	0.0	1.91	0.0	
0.0				
16	0.0	2.18	0.0	
0.0				
17	0.0	0.00	0.0	
9.0			2.10	
21	0.0	0.00	0.0	
9.0	0.0	0.00	0.0	
0.0				
c+d	ic +20 may 7	std ic t2o mou 8	std_ic_t2o_mou_9	std ic mou
	10_120_1110u_/	Jtd_It_tZU_IIIUd_0	3 td_10_t20_iii0d_9	3 ca_rc_iiiou
\ 8	0.0	0.0	0.0	22.
J	0.0	0.0	0.0	22.
13	0.0	0.0	0.0	423.
13	0.0	0.0	0.0	423.

16	0.0		0.0	0.0	87.99
17	0.0		0.0	0.0	9.91
21	0.0		0.0	0.0	81.76
		_ic_mou_8 st	d_ic_mou_9	total_ic_mou_0	6
totat_1c_ 8	_mou_7 \ 4.66	0.75	13.53	103.80	6
28.49 13	68.09	474.41	213.91	968.6	1
172.58					
16 381.56	151.73	82.44	46.24	364.80	0
17	0.00	0.00	1.63	91.88	8
2.31 21	44.21	101.93	112.73	207.09	9
131.89					
		otal_ic_mou_9	spl_ic_mou	u_6 spl_ic_mo	u_7
spl_ic_mo	ou_8 \ 16.54	34.91	Θ	. 00	0.0
0.0	10.54	54.51	0	.00	5.0
13	1144.53	631.86	Θ	. 45	0.0
0.0 16	294.46	334.56	Θ	. 00	0.0
0.0	231110	331130	0		
17	0.00	87.13	0	. 00	0.0
0.0 21	261.04	252.61	A	. 00	0.0
0.0	201.04	232.01	0	.00	5.0
spl_i isd ic mo		_ic_mou_6 is	d_ic_mou_7	isd_ic_mou_8	
8 0.00	0.0	0.00	0.00	0.00	
13	0.0	245.28	62.11	393.39	
259.33	0.0	0.00	0.00	0.22	
16 0.00	0.0	0.00	0.00	0.23	
17	0.0	0.00	0.00	0.00	
0.00 21	0.0	0.00	0.00	0.00	
0.00	0.0	0.00	0.00	0.00	
ic_ot total red		thers_7 ic_o	tners_8 ic_	_others_9	
8	0.00	0.00	0.00	0.00	

19					
13	83.48	16.24	21.44	20.31	
6					
16 10	0.00	0.00	0.00	0.00	
17	0.00	0.00	0.00	0.00	
19	0.00	0.00			
21	0.00	0.00	0.00	0.00	
22					
	total rech num 7	total rech n	um 8 tota	al rech num	9
	al_rech_amt_6 \		_		
8	21		14	1	5
437 13	4		11		7
507					,
16	6		2		1
570	2		1	1	0
17 816	2		4	1	0
21	26		27	1	7
600					
max_	total_rech_amt_7 _rech_amt_6 \			al_rech_amt_	
8	601		120	18	6
90 13	253		717	35	3
110	233		, 1,	33	3
16	348		160	22	0
110 17	0		30	33	5
110	U		30	33	J
21	680		718	68	0
50					
	max_rech_amt_7	max rech amt 8	max rec	h amt 9 las	t dav rch amt 6
8					
8	154	30		36	50
13	110	130		130	110
16	110	130		220	100
17	0	30		130	30
21	50	50		50	30
2.1	30	30		30	30
	last_day_rch_amt	_7 last_day_r	ch_amt_8	last_day_rc	h_amt_9

vol 2g mb 6 \				
8	0	10		Θ
0.0	50	0		0
0.0 16	100	130		220
0.0 17	0	0		0
0.0 21	20	50		30
0.0				
vol_2g_mb_7 8 356.0 13 0.0 16 0.0 17 0.0 21 0.0	vol_2g_mb_8 0.03 0.02 0.00 0.00	vol_2g_mb_9 0.0 0.0 0.0 0.0 0.0	vol_3g_mb_6 v 0.0 0.0 0.0 0.0	ol_3g_mb_7 \ 750.95 0.00 0.00 0.00 0.00
	vol_3g_mb_9	monthly_2g_6	monthly_2g_7	monthly_2g_8
8 11.94	0.0	0	1	0
13 0.00	0.0	0	0	0
16 0.00	0.0	0	0	0
17 0.00	0.0	0	0	0
21 0.00	0.0	Θ	0	0
monthly_2g_9 sachet_2g_9 \		sachet_2g_7		_
8 0	0	1	3	0
13 0		0	3	0
16 0		0	0	Θ
17 0	0	0	0	Θ
21 0		0	0	0
monthly_3g_6 sachet_3g_6 \ 8 0			_8 monthly_3g_ 0	9
0				
13 0 0	(	)	0	0

```
16
                     0
                                                            0
                                                                               0
0
17
                     0
                                                            0
                                                                               0
0
21
                     0
                                                                               0
     sachet 3g 7 sachet 3g 8 sachet 3g 9 aon aug vbc 3g
jul_vbc_3g \
                                     0
                                                        0
                                                             315
                                                                           21.03
8
910.65
                   0
                                                        0
                                                            2607
                                                                             0.00
13
0.00
                   0
16
                                                        0
                                                             511
                                                                             0.00
2.45
17
                   0
                                                        0
                                                             667
                                                                             0.00
0.00
                   0
21
                                                        0
                                                             720
                                                                             0.00
0.00
     jun vbc 3g
                      sep vbc 3g avg rech amt 6 7
                                                                churn
8
           122.16
                                0.0
                                                      519.0
                                                                      0
13
                                0.0
                                                                      0
             0.00
                                                      380.0
16
            21.89
                                0.0
                                                      459.0
                                                                      0
                                                                      0
17
              0.00
                                0.0
                                                      408.0
21
             0.00
                                0.0
                                                      640.0
                                                                      0
# List the columns for churn month(9)
col 9 = [col for col in df.columns.to list() if ' 9' in col]
print(col 9)
['arpu_9', 'onnet_mou_9', 'offnet_mou_9', 'roam_ic_mou_9',
'roam_og_mou_9', 'loc_og_t2t_mou_9', 'loc_og_t2m_mou_9',
'loc_og_t2f_mou_9', 'loc_og_t2c_mou_9', 'loc_og_mou_9',
'std_og_t2t_mou_9', 'std_og_t2m_mou_9', 'std_og_t2f_mou_9',
'std_og_t2c_mou_9', 'std_og_mou_9', 'isd_og_mou_9', 'spl_og_mou_9',
'og_others_9', 'total_og_mou_9', 'loc_ic_t2t_mou_9',
'loc_ic_t2m_mou_9', 'loc_ic_t2f_mou_9', 'loc_ic_mou_9', 
'std_ic_t2t_mou_9', 'std_ic_t2m_mou_9', 'std_ic_t2f_mou_9', 
'std_ic_t2o_mou_9', 'std_ic_mou_9', 'total_ic_mou_9', 'spl_ic_mou_9',
'isd_ic_mou_9', 'ic_others_9', 'total_rech_num_9', 'total_rech_amt_9',
'max_rech_amt_9', 'last_day_rch_amt_9', 'vol_2g_mb_9', 'vol_3g_mb_9', 'monthly_2g_9', 'sachet_2g_9', 'monthly_3g_9', 'sachet_3g_9']
# Deleting the churn month columns
df = df.drop(col 9, axis=1)
# Dropping sep vbc 3g column
df = df.drop('sep_vbc 3g', axis=1)
round(100*(df['churn'].mean()),2)
```

Converting mobile\_number and churn datatype to object:

```
df['mobile number'] = df['mobile number'].astype(object)
df['churn'] = df['churn'].astype(object)
df.info()
<class 'pandas.core.frame.DataFrame'>
Int64Index: 27991 entries, 8 to 99997
Columns: 136 entries, mobile number to churn
dtypes: float64(109), int64(25), object(2)
memory usage: 29.3+ MB
# List only the numeric columns
numeric cols = df.select dtypes(exclude=['object']).columns
print(numeric cols)
Index(['loc_og_t2o_mou', 'std_og_t2o_mou', 'loc_ic_t2o_mou', 'arpu_6',
       'arpu 7', 'arpu 8', 'onnet mou 6', 'onnet mou 7',
'onnet mou 8',
       'offnet mou 6',
       'monthly_3g_7', 'monthly_3g_8', 'sachet_3g_6', 'sachet_3g_7',
       'sachet 3g 8', 'aon', 'aug vbc 3g', 'jul vbc 3g', 'jun vbc 3g',
       'avg rech amt 6 7'],
      dtype='object', length=134)
# Removing outliers below 10th and above 90th percentile
for col in numeric cols:
    q1 = df[col].quantile(0.10)
    q3 = df[col].quantile(0.90)
    iqr = q3-q1
    range low = q1-1.5*iqr
    range high = q3+1.5*iqr
    # Assigning the filtered dataset into data
    data = df.loc[(df[col] > range low) & (df[col] < range high)]</pre>
data.shape
(27705, 136)
# List the columns of total mou, rech num and rech amt
[total for total in data.columns.to list() if 'total' in total]
['total og mou 6',
 'total og mou 7',
 'total og mou 8',
 'total ic mou 6',
 'total ic mou 7',
```

```
'total ic mou 8'
 'total rech num 6',
 'total rech num 7'
 'total rech num 8'
 'total rech amt 6',
 'total_rech_amt_7'
 'total rech amt 8']
# Total mou at good phase incoming and outgoing
data['total_mou_good'] = (data['total_og_mou_6'] +
data['total ic mou 6'])
# Avg. mou at action phase
# We are taking average because there are two months(7 and 8) in
action phase
data['avg mou action'] = (data['total og mou 7'] +
data['total og mou 8'] + data['total ic mou 7'] +
data['total_ic_mou_8'])/2
# Difference avg mou good and avg mou action
data['diff mou'] = data['avg mou action'] - data['total mou good']
# Checking whether the mou has decreased in action phase
data['decrease mou action'] = np.where((data['diff mou'] < 0), 1, 0)</pre>
data.head()
   mobile number loc og t2o mou std og t2o mou loc ic t2o mou
arpu 6 \
      7001524846
                             0.0
                                              0.0
                                                              0.0
378.721
      7002191713
                             0.0
                                              0.0
                                                              0.0
13
492.846
      7000875565
                             0.0
                                              0.0
                                                              0.0
16
430.975
                                                              0.0
17
      7000187447
                             0.0
                                              0.0
690.008
21
     7002124215
                             0.0
                                              0.0
                                                              0.0
514.453
              arpu 8 onnet mou 6 onnet mou 7 onnet mou 8
     arpu 7
offnet mou 6
    492.223 137.362
                           413.69
                                         351.03
                                                       35.08
94.66
13 205.671 593.260
                           501.76
                                         108.39
                                                      534.24
413.31
16 299.869 187.894
                                          74.01
                                                       70.61
                            50.51
296.29
17
                          1185.91
                                           9.28
                                                        7.79
     18.980
              25,499
61.64
21 597.753 637.760
                           102.41
                                         132.11
                                                       85.14
```

757.93						
offne roam ic m		offnet_mou_8	roam_ic	_mou_6 ı	roam_ic_mou	ı_7
8 8	80.63	136.48		0.00	Θ.	. 00
0.00	00105	1301.10		0100	0.	
13	119.28	482.46		23.53	144.	. 24
72.11 16	229.74	162.76		0.00	2	. 83
0.00	229.74	102.70		0.00	۷.	. 03
17	0.00	5.54		0.00	4.	.76
4.81	006 60	002.20		0.00	0	00
21 0.00	896.68	983.39		0.00	Θ.	. 00
roam_ 8 13 16 17 21	og_mou_6 0.00 7.98 0.00 0.00	roam_og_mou_7 0.00 35.26 17.74 8.46 0.00	_	og_mou_8 0.00 1.44 0.00 13.34 0.00	loc_og_t2	2t_mou_6 \ 297.13 49.63 42.61 38.99 4.48
	g_t2t_mou m mou 7	_7 loc_og_t2t	_mou_8	loc_og_t	t2m_mou_6	
8	217.		12.49		80.96	
70.58						
13 47.28	6.	19	36.01		151.13	
16	65.	16	67.38		273.29	
145.99						
17 0.00	0.	00	0.00		58.54	
21	6.	16	23.34		91.81	
87.93						
loc_o loc og t2		_8 loc_og_t2f \	_mou_6	loc_og_t	t2f_mou_7	
8	50.		0.00		0.00	
0.00						
13 23.51	294.	46	4.54		0.00	
16	128.	28	0.00		4.48	
10.26						
17	0.	00	0.00		0.00	
0.00 21	104.	81	0.75		0.00	
1.58			, , ,			
loc_o	g_t2c_mou	_6 loc_og_t2c	_mou_7	loc_og_t	t2c_mou_8	loc_og_mou_6

8	0.0	0.0	7.15	378.09
13	0.0	0.0	0.49	205.31
16	0.0	0.0	0.00	315.91
17	0.0	0.0	0.00	97.54
21	0.0	0.0	0.00	97.04
8 13	_mou_7 loc_0 288.18 53.48 215.64 0.00 94.09	og_mou_8 std_og_ 63.04 353.99 205.93 0.00 129.74	_t2t_mou_6 std_og_ 116.56 446.41 7.89 1146.91 97.93	_t2t_mou_7 \     133.43     85.98     2.58     0.81     125.94
std_og std_og_t2m 8		std_og_t2m_mou_6 13.69	std_og_t2m_mou_7	
75.69 13 156.94	498.23	255.36	52.94	
16 18.29	3.23	22.99	64.51	
17 0.00	0.00	1.55	0.00	
21 876.99	61.79	665.36	808.74	
std_og_t2c	_mou_6 \		std_og_t2f_mou_8	
8	0.0	0.0	0.0	
13 0.0	0.0	0.0	0.0	
16 0.0	0.0	0.0	0.0	
17 0.0	0.0	0.0	0.0	
21 0.0	0.0	0.0	0.0	
std_og 8 13 16 17 21	_t2c_mou_7 0.0 0.0 0.0 0.0 0.0	std_og_t2c_mou_8 0.0 0.0 0.0 0.0 0.0	std_og_mou_6 std 130.26 701.78 30.89 1148.46 763.29	d_og_mou_7 \     143.48     138.93     67.09     0.81     934.69

		isd_og_mou_6	isd_og_mou_7	isd_og_mou_	8
8	mou_6 \ 98.28	0.0	0.0	0.0	9
0.00 13	655.18	0.0	0.0	1.2	9
0.00 16	21.53	0.0	0.0	0.0	9
0.00 17	0.00	0.0	0.0	0.0	9
2.58 21 0.00	938.79	0.0	0.0	0.0	0
	_og_mou_7	spl_og_mou_8	og_others_6	og_others_7	og_others_8
8	0.00	10.23	0.00	0.0	0.0
13	0.00	4.78	0.00	0.0	0.0
16	3.26	5.91	0.00	0.0	0.0
17	0.00	0.00	0.93	0.0	0.0
21	0.00	0.00	0.00	0.0	0.0
	al_og_mou_6 t2t mou 6	total_og_mo	u_7 total_og	_mou_8	
8	508.36		.66	171.56	23.84
13	907.09	192	.41 1	015.26	67.88
16	346.81	286	.01	233.38	41.33
17	1249.53	0	.81	0.00	34.54
21	860.34	1028	.79 1	068.54	2.48
loc_ic_	t2m_mou_7				
8 13.98	9.	84	0.31	57.58	
13 18.53	7.	58	52.58	142.88	
16 149.69	71.	44	28.89	226.81	
17 2.31	Θ.	00	0.00	47.41	
21	10.	19	19.54	118.23	

```
74.63
   loc ic t2m mou 8 loc ic t2f mou 6 loc ic t2f mou 7
loc ic t2f mou 8 \
                                 0.00
              15.48
                                                   0.00
8
0.00
              195.18
                                 4.81
                                                   0.00
13
7.49
              150.16
                                 8.71
                                                   8.68
16
32.71
                                                   0.00
17
               0.00
                                 0.00
0.00
21
              129.16
                                 4.61
                                                   2.84
10.39
   loc ic mou 6 loc ic mou 7
                               loc ic mou 8
                                             std ic t2t mou 6 \
8
          81.43
                        23.83
                                      15.79
                                                         0.00
13
         215.58
                        26.11
                                     255.26
                                                       115.68
                                     211.78
16
         276.86
                       229.83
                                                        68.79
                                       0.00
17
          81.96
                         2.31
                                                         8.63
21
                                     159.11
          125.33
                        87.68
                                                        14.06
    std ic t2m mou 7 \
               0.58
                                 0.10
                                                  22.43
8
4.08
13
              38.29
                               154.58
                                                 308.13
29.79
16
              78.64
                                 6.33
                                                  18.68
73.08
                                                   1.28
17
               0.00
                                 0.00
0.00
21
               5.98
                                 0.18
                                                  67.69
38.23
   std ic t2m mou 8 std ic t2f mou 6 std ic t2f mou 7
std ic t2f mou 8 \
8
               0.65
                                 0.00
                                                    0.0
0.00
13
             317.91
                                 0.00
                                                    0.0
1.91
16
              73.93
                                 0.51
                                                    0.0
2.18
               0.00
                                 0.00
                                                    0.0
17
0.00
              101.74
                                                    0.0
21
                                 0.00
0.00
   std_ic_t2o_mou_6 std_ic_t2o_mou_7 std_ic_t2o_mou_8 std_ic_mou_6
```

8	0.0		0.0	0.0	22.43
13	0.0		0.0	0.0	423.81
16	0.0		0.0	0.0	87.99
17	0.0		0.0	0.0	9.91
21	0.0		0.0	0.0	81.76
					02170
std_i 8 13 16 17 21	ic_mou_7 sto 4.66 68.09 151.73 0.00 44.21	M_ic_mou_8 0.75 474.41 82.44 0.00 101.93	total_ic_mou_6 103.86 968.61 364.86 91.88 207.09	5 - 1 L 1 5 38	mou_7 \ 28.49 72.58 81.56 2.31 31.89
total		spl_ic_mou_6	spl_ic_mou_7	7 spl_ic_mo	u_8
8	16.54	0.00	0.0	) (	9.0
0.00 13	1144.53	0.45	0.0	) (	9.0
245.28 16	294.46	0.00	0.0	) (	9.0
0.00 17	0.00	0.00	0.0	) (	9.0
0.00 21	261.04	0.00	0.0		9.0
0.00	201104	0.00	0.0	,	0.0
	ic_mou_7 isc	l_ic_mou_8	ic_others_6 i	ic_others_7	ic_others_8
8	0.00	0.00	0.00	0.00	0.00
13	62.11	393.39	83.48	16.24	21.44
16	0.00	0.23	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00
total total_red	L_rech_num_6 ch amt 6 \	total_rech	_num_7 total_	_rech_num_8	
8 437	19		21	14	
13 507	6		4	11	
16	10		6	2	

570 17		19	2		4	
816 21		22	26		27	
600						
\	total_rech_amt	_7 total_r	ech_amt_8	max_rech_amt_	_6 max_rech_a	amt_7
8	6	01	120	Ğ	90	154
13	2	53	717	11	10	110
16	3	48	160	11	10	110
17		0	30	11	10	0
21	6	80	718		50	50
8 13 16 17 21 vol 8 0.0 13 0.0 16 0.0 21 0.0			- 50 110 100 30 30	last_day_rch2g_mb_7 vol 356.0 0.0 0.0 0.0 0.0	- 0 50 100 0 20	
	vol_3g_mb_7 v	ol_3g_mb_8	monthly_2g	_6 monthly_2	2g_7 monthly	_2g_8
8	750.95	11.94		0	1	0
13	0.00	0.00		0	0	0
16	0.00	0.00		0	0	0
17	0.00	0.00		0	0	0
21	0.00	0.00		0	0	0

```
sachet 2g 6 sachet 2g 7 sachet 2g 8 monthly 3g 6 monthly 3g 7
/
8
               0
                            1
                                          3
                                                                        0
13
               0
                            0
                                          3
                                                                        0
               0
                                          0
                                                                        0
16
17
               0
                            0
                                          0
                                                                        0
21
               0
                            0
                                          0
                                                                        0
    monthly 3g 8 sachet 3g 6 sachet 3g 7 sachet 3g 8
                                                             aon
aug vbc 3g \
                0
                              0
                                           0
                                                         0
8
                                                             315
21.03
                0
                              0
                                           0
                                                         0
13
                                                            2607
0.00
16
                0
                              0
                                           0
                                                             511
0.00
17
                0
                              0
                                           0
                                                         0
                                                             667
0.00
                0
                                           0
21
                              0
                                                             720
0.00
                                                       total mou_good \
    jul vbc 3g
                jun vbc 3g
                             avg rech amt 6 7 churn
        910.65
                     122.16
8
                                         519.0
                                                    0
                                                                612.22
13
          0.00
                                                    0
                       0.00
                                         380.0
                                                               1875.70
16
          2.45
                      21.89
                                         459.0
                                                    0
                                                                711.67
          0.00
                       0.00
                                                    0
                                                               1341.41
17
                                         408.0
21
          0.00
                       0.00
                                         640.0
                                                    0
                                                               1067.43
    avg mou action diff mou
                               decrease mou action
8
           324.125
                     -288.095
                                                   1
13
          1262.390
                    -613.310
                                                   1
                                                   1
16
           597.705
                     -113.965
17
              1.560 -1339.850
                                                   1
21
                                                   0
          1245.130
                      177.700
# Avg rech number at action phase
data['avg rech num action'] = (data['total rech num 7'] +
data['total_rech_num_8'])/2
# Difference total rech num 6 and avg rech action
data['diff rech num'] = data['avg rech num action'] -
data['total rech num 6']
```

```
# Checking if rech num has decreased in action phase
data['decrease rech num action'] = np.where((data['diff rech num'] <</pre>
0), 1, 0)
data.head()
   mobile number loc og t2o mou std og t2o mou loc ic t2o mou
arpu 6 \
     7001524846
8
                              0.0
                                               0.0
                                                                0.0
378.721
                                                                0.0
13
      7002191713
                              0.0
                                               0.0
492.846
                              0.0
                                               0.0
                                                                0.0
16
      7000875565
430.975
17
      7000187447
                              0.0
                                               0.0
                                                                0.0
690,008
                              0.0
                                               0.0
                                                                0.0
21
      7002124215
514.453
              arpu 8 onnet mou 6 onnet mou 7 onnet mou 8
     arpu 7
offnet mou 6 \
    492.223 137.362
                            413.69
                                          351.03
                                                        35.08
94.66
13 205.671
             593,260
                            501.76
                                          108.39
                                                       534.24
413.31
16 299.869 187.894
                             50.51
                                           74.01
                                                        70.61
296.29
17 18.980
              25.499
                           1185.91
                                            9.28
                                                         7.79
61.64
                            102.41
21 597.753
             637.760
                                          132.11
                                                        85.14
757.93
                  offnet mou 8 roam ic mou 6 roam ic mou 7
    offnet mou 7
roam ic mou 8 \
8
           80.63
                         136.48
                                           0.00
                                                          0.00
0.00
13
          119.28
                         482.46
                                          23.53
                                                        144.24
72.11
          229.74
                         162.76
16
                                           0.00
                                                          2.83
0.00
17
            0.00
                           5.54
                                           0.00
                                                          4.76
4.81
21
          896.68
                         983.39
                                           0.00
                                                          0.00
0.00
                                   roam og mou 8
    roam og mou 6
                    roam og mou 7
                                                   loc og t2t mou 6 \
8
             0.00
                             0.00
                                             0.00
                                                              297.13
13
             7.98
                            35.26
                                             1.44
                                                              49.63
             0.00
                            17.74
                                             0.00
                                                              42.61
16
17
             0.00
                             8.46
                                            13.34
                                                              38.99
```

21	0.00	0.00	0.00	4.48
		loc_og_t2t_mou_8	loc_og_t2m_mou_6	
8	n_mou_7 \ 217.59	12.49	80.96	
70.58 13 47.28	6.19	36.01	151.13	
16 145.99	65.16	67.38	273.29	
143.99 17 0.00	0.00	0.00	58.54	
21 87.93	6.16	23.34	91.81	
loc_og loc og t2f		loc_og_t2f_mou_6	loc_og_t2f_mou_7	
8 0.00	50.54	0.00	0.00	
13 23.51	294.46	4.54	0.00	
16 10.26	128.28	0.00	4.48	
17 0.00	0.00	0.00	0.00	
21 1.58	104.81	0.75	0.00	
	ı t2c mou 6	loc og t2c mou 7	loc og t2c mou 8	loc oa mou 6
\	0.0	0.0	7.15	378.09
13	0.0	0.0	0.49	205.31
16	0.0	0.0	0.00	315.91
17	0.0	0.0	0.00	97.54
21	0.0	0.0	0.00	97.04
8 13	_mou_7 loc_ 288.18 53.48 215.64 0.00 94.09	_og_mou_8 std_og_ 63.04 353.99 205.93 0.00 129.74	t2t_mou_6 std_og_ 116.56 446.41 7.89 1146.91 97.93	t2t_mou_7 \     133.43     85.98     2.58     0.81     125.94
std_og std_og_t2m	j_t2t_mou_8 n_mou_8 \	std_og_t2m_mou_6	std_og_t2m_mou_7	

8 75.6		2.58	1	3.69		10.04		
13	498	8.23	25	5.36		52.94	Ĺ	
156. 16		3.23	2	2.99		64.51		
18.2 17		0.00		1.55		0.00	)	
0.00		1.79	66	5.36		808.74		
876.								
s+d	std_og_t2f_moog_t2c_mou_6		_og_t2f_m	iou_7	std_og	_t2f_mou_8		
8 -	_09_1260u_0	0.0		0.0		0.0		
0.0		0.0		0.0		0.0		
0.0 16		0.0		0.0		0.0	)	
0.0 17		0.0		0.0		0.0		
0.0 21		0.0		0.0		0.0		
0.0								
8 13 16 17 21	std_og_t2c_m	ou_7 std 0.0 0.0 0.0 0.0 0.0	_og_t2c_m	0.0 0.0 0.0 0.0 0.0 0.0	1	_mou_6 st 130.26 701.78 30.89 148.46 763.29	d_og_mou 143. 138. 67. 0. 934.	48 93 09 81
1	std_og_mou_8	isd_og_	mou_6 is	d_og_m	ou_7	isd_og_mou	ı <u>_</u> 8	
8	og_mou_6 \ 98.28		0.0		0.0	0.	00	
0.00	655.18		0.0		0.0	1.	29	
0.00 16	21.53		0.0		0.0	0.	00	
0.00 17	0.00		0.0		0.0	0.	00	
2.58 21	938.79		0.0		0.0	0.	00	
0.00	)							
\	spl_og_mou_7	spl_og_ı	mou_8 og	_other	`s_6 o	g_others_7	og_oth	ers_8
8	0.00		10.23	0	0.00	0.0		0.0
13	0.00		4.78	Θ	0.00	0.0		0.0

16	3.26	5.91	0.00	0.0	0.0
17	0.00	0.00	0.93	0.0	0.0
21	0.00	0.00	0.00	0.0	0.0
	L_og_mou_6 t 2t mou 6 \	otal_og_mou_7	total_og_mo	ou_8	
8	508.36	431.66	177	1.56	23.84
13	907.09	192.41	1015	5.26	67.88
16	346.81	286.01	233	3.38	41.33
17	1249.53	0.81	(	9.00	34.54
21	860.34	1028.79	1068	3.54	2.48
	ic_t2t_mou_7 2m mou 7 \	loc_ic_t2t_mou	_8 loc_ic_	_t2m_mou_6	
8 13.98	9.84	0.	31	57.58	
13	7.58	52.	58	142.88	
18.53 16	71.44	28.	89	226.81	
149.69 17	0.00	0.	00	47.41	
2.31 21	10.19	19.	54	118.23	
74.63	10113	131	<i>3</i> 1	110.23	
		loc_ic_t2f_mou	_6 loc_ic_	_t2f_mou_7	
8	2f_mou_8 \ 15.48	0.	00	0.00	
0.00 13	195.18	4.	81	0.00	
7.49 16	150.16	Q	71	8.68	
32.71					
17 0.00	0.00		00	0.00	
21 10.39	129.16	4.	61	2.84	
loc i	ic_mou_6 loc	ic mou 7 loc	ic mou 8 s	std ic t2t mou	6 \
8 13	81.43 215.58	23.83 26.11	15.79 255.26	0. 115.	<u>0</u> 0
16	276.86	229.83	211.78	68.	

17 21	81.96 125.33	2.31 87.68 1	0.00 59.11	8.63 14.06
	std_ic_t2t_mou_7 .c t2m mou 7 \	std_ic_t2t_mou_8	std_ic_t2m_mou_6	
8 4.08	0.58	0.10	22.43	
13 29.79	38.29	154.58	308.13	
16 73.08	78.64	6.33	18.68	
17 0.00	0.00	0.00	1.28	
21 38.23	5.98	0.18	67.69	
	std_ic_t2m_mou_8 .c_t2f_mou_8 \	std_ic_t2f_mou_6	std_ic_t2f_mou_7	
8	0.65	0.00	0.0	
13 1.91	317.91	0.00	0.0	
16	73.93	0.51	0.0	
2.18 17	0.00	0.00	0.0	
0.00	101.74	0.00	0.0	
0.00				
\		std_ic_t2o_mou_7		
8	0.0	0.0	0.0	22.43
13	0.0	0.0	0.0	423.81
16	0.0	0.0	0.0	87.99
17	0.0	0.0	0.0	9.91
21	0.0	0.0	0.0	81.76
8 13 16 17 21	std_ic_mou_7 std 4.66 68.09 151.73 0.00 44.21	_ic_mou_8 total_i 0.75 474.41 82.44 0.00 101.93	364.86 91.88	_mou_7 \ 28.49 172.58 381.56 2.31 131.89
t	otal_ic_mou_8 s	pl_ic_mou_6 spl_i	c_mou_7 spl_ic_m	ou_8

isd_ 8	_ic_mou_6 \ 16.54	0.00	Θ	. 0	0.0
0.00	)				
13 245	.28 1144.53	0.45	Θ	.0	0.0
16 0.00	294.46	0.00	0	. 0	0.0
17	0.00	0.00	0	.0	0.0
0.00 21	) 261.04	0.00	0	.0	0.0
0.00					
	isd_ic_mou_7 is	d_ic_mou_8 i	c_others_6	ic_others_7	ic_others_8
8	0.00	0.00	0.00	0.00	0.00
13	62.11	393.39	83.48	16.24	21.44
16	0.00	0.23	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00
tota	total_rech_num_6 al rech amt 6  \	total_rech_i	num_7 tota	l_rech_num_8	
8	19		21	14	
437 13	6		4	11	
507 16	16		6	2	
570					
17 816	19		2	4	
21 600	22		26	27	
	total_rech_amt_7	total rech	amt Q may	rach amt 6	max_rech_amt_7
\ 8					
8	601		120	90	154
13	253		717	110	110
16	348		160	110	110
17	6		30	110	Θ
21	686		718	50	50

8 13 16 17 21		t_8 last_day_ 30 130 130 30 50	rch_amt_6 l 50 110 100 30 30	ast_day_rch_am	t_7 \ 0 50 100 0 20	
vol.		n_amt_8 vol_2	2g_mb_6 vol_	2g_mb_7 vol_2	g_mb_8	
8	_3g_mb_6 \	10	0.0	356.0	0.03	
0.0		Θ	0.0	0.0	0.02	
0.0 16		130	0.0	0.0	0.00	
0.0 17		Θ	0.0	0.0	0.00	
0.0 21		50	0.0	0.0	0.00	
0.0						
\	vol_3g_mb_7	vol_3g_mb_8	monthly_2g_	6 monthly_2g_	7 monthly_2g	_8
8	750.95	11.94		0	1	0
13	0.00	0.00		0	9	0
16	0.00	0.00		0	9	0
17	0.00	0.00		0	9	0
21	0.00	0.00		0	9	0
\	sachet_2g_6	sachet_2g_7	sachet_2g_8	monthly_3g_6	monthly_3g_	7
8	0	1	3	0		0
13	0	0	3	0		0
16	0	0	0	0		0
17	0	0	0	9		0
21	0	0	0	9		0
		3 sachet_3g_6	S sachet_3g_	7 sachet_3g_8	aon	
8	_vbc_3g \ (	9 6	)	0 0	315	
21. 13		9 (	)	0 0	2607	

```
0.00
16
               0
                             0
                                           0
                                                         0
                                                             511
0.00
               0
                                           0
17
                                                             667
0.00
               0
                             0
21
                                           0
                                                             720
0.00
                             avg_rech_amt_6_7 churn
    jul_vbc_3g
                jun_vbc_3g
                                                      total_mou_good \
8
        910.65
                     122.16
                                         519.0
                                                               612.22
                                                   0
13
          0.00
                       0.00
                                         380.0
                                                   0
                                                              1875.70
          2.45
                      21.89
                                         459.0
                                                   0
                                                               711.67
16
          0.00
                       0.00
17
                                         408.0
                                                   0
                                                              1341.41
21
          0.00
                       0.00
                                         640.0
                                                   0
                                                              1067.43
    avg mou action diff mou
                               decrease mou action avg rech num action
/
8
           324.125
                    -288.095
                                                                      17.5
                                                  1
                                                                       7.5
13
          1262.390
                     -613.310
                                                   1
16
           597.705
                                                                       4.0
                     -113.965
                                                   1
                                                                       3.0
17
             1.560 - 1339.850
                                                   1
21
                                                                      26.5
          1245.130
                      177.700
                                                  0
    diff rech num
                    decrease rech num action
8
             -1.5
                                            1
13
              1.5
                                            0
                                            1
16
             -6.0
17
            -16.0
                                            1
21
                                            0
              4.5
# Avg rech amt in action phase
data['avg rech amt action'] = (data['total rech amt 7'] +
data['total rech amt 8'])/2
# Difference of action phase rech amt and good phase rech amt
data['diff_rech_amt'] = data['avg_rech_amt_action'] -
data['total rech amt 6']
# Checking if rech amt has decreased in action phase
data['decrease rech amt action'] = np.where((data['diff rech amt'] <</pre>
0), 1, 0)
data.head()
   mobile number loc og t2o_mou std_og_t2o_mou loc_ic_t2o_mou
arpu 6 \
```

8 70 378.721	00152	4846		0	. 0		0.	0		0.0
13 70	00219	1713		0	. 0		0.	0		0.0
	00087	5565		0	. 0		0.	0		0.0
430.975 17 70	00018	7447		0	. 0		0.	0		0.0
690.008 21 70	00212	4215		0	. 0		Θ.	0		0.0
514.453										
arı offnet n			u_8	onnet_mo	u_6	onnet	_mou_7	onnet_m	ou_8	
		137.	362	413	. 69		351.03	3	5.08	
13 205 413.31	.671	593.	260	501	.76		108.39	53	4.24	
16 299	.869	187.	894	50	.51		74.01	7	0.61	
296.29 17 18	.980	25.	499	1185	.91		9.28		7.79	
61.64 21 597	.753	637.	760	102	.41		132.11	8	5.14	
757.93										
offi roam_ic			off	net_mou_8	ro	am_ic_	mou_6	roam_ic_	mou_7	
8	8	0.63		136.48			0.00		0.00	
13 72.11	11	9.28		482.46			23.53	1	44.24	
16 0.00	22	9.74		162.76			0.00		2.83	
17		0.00		5.54			0.00		4.76	
4.81	89	6.68		983.39			0.00		0.00	
0.00					_			_		
8	n_og_	mou_6 0.00		am_og_mou 0.	<u>0</u> 0	roam_o	g_mou_8 0.00		$-{2}$	$97.\overline{1}3$
13 16		7.98 0.00		35. 17.			1.44 0.00			49.63 42.61
17 21		0.00		8. 0.			13.34			38.99 4.48
	og t			loc og t		ou 8			6	
loc_og_ <sup>5</sup> 8		ou_7			_	- 2.49		80.9		
70.58 13			. 19			6.01		151.1		
47.28		J	. 13			0.01		13111	.5	

16	65.16	67.38	273.29	
145.99 17	0.00	0.00	58.54	
0.00 21 87.93	6.16	23.34	91.81	
	+2m mau 9	loc og t2f mou 6	loc og t2f mou 7	
loc_og_t2f	_mou_8 \			
8 0.00	50.54	0.00	0.00	
13	294.46	4.54	0.00	
23.51 16	128.28	0.00	4.48	
10.26				
17 0.00	0.00	0.00	0.00	
21 1.58	104.81	0.75	0.00	
	±2	1	1 +2 0	1
\	_tzc_mou_6	loc_og_tzc_mou_/	loc_og_t2c_mou_8	toc_og_mou_o
8	0.0	0.0	7.15	378.09
13	0.0	0.0	0.49	205.31
16	0.0	0.0	0.00	315.91
17	0.0	0.0	0.00	97.54
21	0.0	0.0	0.00	97.04
-	7 1	0		
	_mou_7 loc_ 288.18	og_mou_8 std_og_ 63.04	_t2t_mou_6	t2t_mou_7 \ 133.43
13 16	53.48 215.64	353.99 205.93	446.41 7.89	85.98 2.58
17	0.00	0.00	1146.91	0.81
21	94.09	129.74	97.93	125.94
		std_og_t2m_mou_6	std_og_t2m_mou_7	
std_og_t2m 8	_mou_8 \ 22.58	13.69	10.04	
75.69	400 22	255 26	F2 04	
13 156.94	498.23	255.36	52.94	
16 18.29	3.23	22.99	64.51	
17	0.00	1.55	0.00	
0.00				

21 876.99	61.7	9	665.36	86	08.74	
std_og_	d_og_t2f_mou_ _t2c_mou_6 \			std_og_t2f_m	_	
8 0.0	0.	0	0.0		0.0	
13	0.	0	0.0		0.0	
0.0 16	0.	0	0.0		0.0	
0.0 17	0.	Θ	0.0		0.0	
0.0					0.0	
21 0.0	0.	U	0.0		0.0	
sto 8 13 16 17 21	d_og_t2c_mou_ 0. 0. 0. 0. 0.	0 0 0 0	c_mou_8 s 0.0 0.0 0.0 0.0 0.0	std_og_mou_6 130.26 701.78 30.89 1148.46 763.29	- 3 3 5	og_mou_7 \ 143.48 138.93 67.09 0.81 934.69
sto	d_og_mou_8 i	.sd_og_mou_6	isd og mo	ou 7 isd og	mou 8	
	o_6 \ _mou_6 \ _98.28	0.0		0.0	0.00	
0.00						
13 0.00	655.18	0.0		0.0	1.29	
16 0.00	21.53	0.0		0.0	0.00	
17	0.00	0.0		0.0	0.00	
2.58 21	938.79	0.0		0.0	0.00	
0.00						
	l_og_mou_7 s	pl_og_mou_8	og_others	s_6 og_othe	ers_7 o	g_others_8
8	0.00	10.23	0.	. 00	0.0	0.0
13	0.00	4.78	0.	. 00	0.0	0.0
16	3.26	5.91	0.	. 00	0.0	0.0
17	0.00	0.00	0.	. 93	0.0	0.0
21	0.00	0.00	0.	.00	0.0	0.0
to	tal_og_mou_6	total_og_mo	u_7 total	l_og_mou_8		

loc_ic_t2 8	t_mou_6 \ 508.36	431.66	171.56	23.84
13	907.09	192.41	1015.26	67.88
16	346.81	286.01	233.38	41.33
17	1249.53	0.81	0.00	34.54
21	860.34	1028.79	1068.54	2.48
loc i	c t2t mou 7	loc ic t2t mou 8	loc ic t2m mou 6	
	m_mou_7 \ 9.84	0.31	57.58	
13.98 13	7.58	52.58	142.88	
18.53				
16 149.69	71.44	28.89	226.81	
17 2.31	0.00	0.00	47.41	
21 74.63	10.19	19.54	118.23	
		loc_ic_t2f_mou_6	loc_ic_t2f_mou_7	
8	f_mou_8 \ 15.48	0.00	0.00	
0.00 13	195.18	4.81	0.00	
7.49 16	150.16	8.71	8.68	
32.71 17	0.00	0.00	0.00	
0.00 21	129.16	4.61	2.84	
10.39				
loc_i 8 13 16 17 21	c_mou_6 loc_ 81.43 215.58 276.86 81.96 125.33	26.11 2 229.83 2 2.31	15.79	_mou_6 \     0.00 115.68 68.79 8.63 14.06
	c_t2t_mou_7 m mou 7 \	std_ic_t2t_mou_8	std_ic_t2m_mou_6	
8 4.08	0.58	0.10	22.43	
13	38.29	154.58	308.13	

29.79			_		
16	78.64	6.3	3	18.68	
73.08	0.00	0.0	10	1 20	
17 0.00	0.00	0.0	00	1.28	
21	5.98	0.1	Q	67.69	
38.23	3.90	0.1	.0	07.09	
30.23					
std ic	t2m mou 8	std ic t2f mou	6 std ic	t2f mou 7	
std ic t2f		5 cd_10_c1od_	_0 014_10_		
8	0.65	0.0	ιΘ	0.0	
0.00			-		
13	317.91	0.0	10	0.0	
1.91					
16	73.93	0.5	1	0.0	
2.18					
17	0.00	0.0	0	0.0	
0.00					
21	101.74	0.0	0	0.0	
0.00					
	_t2o_mou_6	std_ic_t2o_mou_	_/ std_1c_	_t2o_mou_8	std_ic_mou_6
8	0 0	0	0	0.0	22 42
8	0.0	0.	U	0.0	22.43
13	0.0	0.	Θ	0.0	423.81
13	0.10	01	· ·	010	123101
16	0.0	0.	Θ	0.0	87.99
17	0.0	0.	0	0.0	9.91
					24 -2
21	0.0	0.	Θ	0.0	81.76
std ic	mou 7 std	ic mou 8 total	ic mou 6	total ic	mou 7 \
8	4.66	0.75	103.86		28.49
13	68.09	474.41	968.61		72.58
	151.73	82.44	364.86		81.56
17	0.00	0.00	91.88	_	2.31
21	44.21	101.93	207.09	1	31.89
		pl_ic_mou_6 spl	_ic_mou_7	spl_ic_mo	u_8
isd_ic_mou_					
8	16.54	0.00	0.0		0.0
0.00	1144	0 1-	•		0.0
13	1144.53	0.45	0.0		0.0
245.28	204 46	0.00	0.0		0 0
16	294.46	0.00	0.0		0.0
0.00 17	0.00	0.00	0.0		0.0
1/	0.00	0.00	0.0		0.0

0.00	261.04	0.00	9 0	0.0	0.0
0.00					
\	isd_ic_mou_7 is	sd_ic_mou_8	ic_others_6	ic_others_7	ic_others_8
8	0.00	0.00	0.00	0.00	0.00
13	62.11	393.39	83.48	16.24	21.44
16	0.00	0.23	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00
	total rech num 6	o total rech	n num 7 tota	al rech num 8	
tota 8	al_rech_amt_6  \ 19	_	21	14	
437					
13 507			4	11	
16 570	16	)	6	2	
17 816	19	)	2	4	
21 600	22	2	26	27	
000	total_rech_amt_7	7 total rech	n amt 8 max	rech amt 6 i	max rech amt 7
8	601	_	120	90	154
13	253		717	110	110
16	348		160	110	110
17	(	)	30	110	0
21	686	)	718	50	50
8 13 16 17 21	max_rech_amt_8 30 130 130 30 50	last_day_rch	n_amt_6 last 50 110 100 30 30	1	_7 \ 0 50 90 0 20
	last_day_rch_amt	_8 vol_2g_r	mb_6 vol_2g_	_mb_7 vol_2g	_mb_8

_	_3g_mb_0	6 \				
8			10	0.0	356.0	0.03
13 0.0			0	0.0	0.0	0.02
16			130	0.0	0.0	0.00
0.0 17			0	0.0	0.0	0.00
0.0 21 0.0			50	0.0	0.0	0.00
	vol_3g	_mb_7	vol_3g_mb_8	monthly_2g_6	monthly_2g_	7 monthly_2g_8
8	7:	50.95	11.94	0		1 0
13		0.00	0.00	0		0 0
16		0.00	0.00	0		0 0
17		0.00	0.00	Θ		0 0
21		0.00	0.00	0		0 0
\	sachet_	_2g_6	sachet_2g_7	sachet_2g_8	monthly_3g_6	monthly_3g_7
8		0	1	3	0	0
13		0	0	3	0	Θ
16		0	0	0	0	0
17		Θ	Θ	0	0	0
21		0	0	0	0	0
aug	monthly _vbc_3g	y_3g_8 \	sachet_3g_6	sachet_3g_7	sachet_3g_8	aon
8 21.6		0	0	Θ	0	315
13		0	0	0	0	2607
0.00 16		0	0	0	0	511
0.00 17	9	0	0	0	Θ	667
0.00	9	Θ	0	0	0	720
0.00	9		Ū	v	· ·	

```
jul vbc 3g
                jun vbc 3g
                             avg rech amt 6 7 churn total mou good \
8
        910.65
                     122.16
                                         519.0
                                                   0
                                                               612.22
13
          0.00
                       0.00
                                         380.0
                                                   0
                                                              1875.70
                                         459.0
                      21.89
16
          2.45
                                                   0
                                                               711.67
                       0.00
17
          0.00
                                         408.0
                                                   0
                                                              1341.41
21
          0.00
                       0.00
                                         640.0
                                                   0
                                                              1067.43
    avg mou action diff mou
                               decrease mou action avg rech num action
8
           324.125
                     -288.095
                                                  1
                                                                     17.5
13
          1262.390
                                                                      7.5
                    -613.310
16
           597.705
                     -113.965
                                                  1
                                                                      4.0
17
             1.560 -1339.850
                                                                      3.0
                                                  1
21
                                                  0
                                                                     26.5
          1245.130
                      177.700
    diff rech num
                    decrease rech num action
                                               avg rech amt action
8
             -1.5
                                            1
                                                              360.5
13
              1.5
                                            0
                                                              485.0
                                            1
              -6.0
                                                              254.0
16
17
            -16.0
                                            1
                                                               15.0
21
              4.5
                                            0
                                                              699.0
    diff rech amt
                    decrease_rech_amt_action
8
            -76.5
                                            1
13
            -22.0
           -316.0
                                            1
16
                                            1
17
           -801.0
21
             99.0
                                            0
# ARUP in action phase
data['avg arpu action'] = (data['arpu 7'] + data['arpu 8'])/2
# Difference of good and action phase ARPU
data['diff_arpu'] = data['avg_arpu_action'] - data['arpu_6']
# Checking whether the arpu has decreased on the action month
data['decrease arpu action'] = np.where(data['diff arpu'] < 0, 1, 0)</pre>
data.head()
   mobile_number loc_og_t2o_mou std_og_t2o_mou loc_ic_t2o_mou
arpu 6 \
      7001524846
                              0.0
                                               0.0
                                                                0.0
8
378,721
                              0.0
                                               0.0
                                                                0.0
13
      7002191713
492.846
```

16 7000875565 430.975	0.0	0.0	0.0
17 7000187447 690.008	0.0	0.0	0.0
21 7002124215 514.453	0.0	0.0	0.0
arpu_7 arpu_offnet mou 6 \	_8 onnet_mou_6	onnet_mou_7 onnet	_mou_8
8 492.223 137.30 94.66	62 413.69	351.03	35.08
13 205.671 593.20 413.31	50 501.76	108.39	534.24
16 299.869 187.89 296.29	94 50.51	74.01	70.61
17 18.980 25.49 61.64	99 1185.91	9.28	7.79
21 597.753 637.76 757.93	102.41	132.11	85.14
	offnet mou 8 roa	am ic mou 6 roam i	c mou 7
roam_ic_mou_8 \ 8 80.63	136.48	0.00	0.00
0.00 13 119.28	482.46	23.53	144.24
72.11 16 229.74	162.76	0.00	2.83
0.00 17 0.00	5.54	0.00	4.76
4.81 21 896.68 0.00	983.39	0.00	0.00
roam_og_mou_6 8 0.00 13 7.98 16 0.00 17 0.00 21 0.00	roam_og_mou_7 0.00 35.26 17.74 8.46 0.00	roam_og_mou_8 loc_ 0.00 1.44 0.00 13.34 0.00	
loc_og_t2t_mou loc og t2m mou 7		ou_8 loc_og_t2m_mo	u_6
8 217.5 70.58		2.49 80	.96
13 6.3 47.28	19 36	5.01 151	. 13
16 65.1 145.99	16 67	7.38 273	.29
17 0.0 0.00	90	9.00 58	.54

21 87.93	6.16	23.34	91.81	
	g_t2m_mou_8 f_mou_8 \	loc_og_t2f_mou_6	loc_og_t2f_mou_7	
8	50.54	0.00	0.00	
0.00 13 23.51	294.46	4.54	0.00	
16	128.28	0.00	4.48	
10.26 17	0.00	0.00	0.00	
0.00 21	104.81	0.75	0.00	
1.58				
loc_o	g_t2c_mou_6	loc_og_t2c_mou_7	loc_og_t2c_mou_8	loc_og_mou_6
8	0.0	0.0	7.15	378.09
13	0.0	0.0	0.49	205.31
16	0.0	0.0	0.00	315.91
17	0.0	0.0	0.00	97.54
21	0.0	0.0	0.00	97.04
loc_og 8 13 16 17 21	g_mou_7 loc 288.18 53.48 215.64 0.00 94.09	_og_mou_8 std_og_ 63.04 353.99 205.93 0.00 129.74	t2t_mou_6 std_og_ 116.56 446.41 7.89 1146.91 97.93	t2t_mou_7 \ 133.43 85.98 2.58 0.81 125.94
	g_t2t_mou_8 m mou 8 \	std_og_t2m_mou_6	std_og_t2m_mou_7	
8 75.69	22.58	13.69	10.04	
13	498.23	255.36	52.94	
156.94 16	3.23	22.99	64.51	
18.29 17	0.00	1.55	0.00	
0.00 21 876.99	61.79	665.36	808.74	
std_o	g_t2f_mou_6	std_og_t2f_mou_7	std_og_t2f_mou_8	

	t2c_mou_6 \	0	0	0.0	
8 0.0	0.0	U	. 0	0.0	
13	0.0	0	. 0	0.0	
0.0 16	0.0	۵	0	0.0	
0.0	0.0	U	. 0	0.0	
17	0.0	0	. 0	0.0	
0.0 21	0.0	۵	. 0	0.0	
0.0	0.0	U	. 0	0.0	
					_ ,
std <sub>.</sub> 8	_og_t2c_mou_7	std_og_t2c_mou_ ຄ		ou_6 std_og_ 0.26 1	mou_7 \ 43.48
13	0.0				38.93
16	0.0	0	.0 30		67.09
17	0.0		.0 1148		0.81
21	0.0	0	.0 763	3.29 9	34.69
std	_og_mou_8 isd_c	og mou 6 isd o	og mou 7 iso	d og mou 8	
	mou_6 \				
8	98.28	0.0	0.0	0.00	
0.00 13	655.18	0.0	0.0	1.29	
0.00	033110	010	0.0	1123	
16	21.53	0.0	0.0	0.00	
0.00 17	0.00	0.0	0.0	0.00	
2.58					
21	938.79	0.0	0.0	0.00	
0.00					
spl <sub>.</sub>	_og_mou_7 spl_c	og_mou_8 og_o	thers_6 og_c	others_7 og_	others_8
8	0.00	10.23	0.00	0.0	0.0
13	0.00	4.78	0.00	0.0	0.0
16	3.26	5.91	0.00	0.0	0.0
17	0.00	0.00	0.93	0.0	0.0
21	0.00	0.00	0.00	0.0	0.0
		:al_og_mou_7	total_og_mou_	_8	
loc_1c_ 8	t2t_mou_6 \ 508.36	431.66	171.5	56	23.84
		731.00	1/1.5	,,	
13	907.09	192.41	1015.2	26	67.88

16	346.81	286.01	233.38	41.33
17	1249.53	0.81	0.00	34.54
21	860.34	1028.79	1068.54	2.48
		loc_ic_t2t_mou_8	loc_ic_t2m_mou_6	
8	2m_mou_7 \ 9.84	0.31	57.58	
13.98 13	7.58	52.58	142.88	
18.53				
16 149.69	71.44	28.89	226.81	
17 2.31	0.00	0.00	47.41	
21	10.19	19.54	118.23	
74.63				
	ic_t2m_mou_8 2f_mou_8 \	loc_ic_t2f_mou_6	loc_ic_t2f_mou_7	
8	15.48	0.00	0.00	
0.00 13	195.18	4.81	0.00	
7.49				
16 32.71	150.16	8.71	8.68	
17	0.00	0.00	0.00	
0.00 21	129.16	4.61	2.84	
10.39				
_			mou_8 std_ic_t2t	_
8 13	81.43 215.58	23.83 26.11 2	15.79 55.26	0.00 115.68
16	276.86		11.78 0.00	68.79
17 21	81.96 125.33	2.31 87.68 1	59.11	8.63 14.06
std i	ic t2t mou 7	std ic t2t mou 8	std ic t2m mou 6	
std_ic_t2	2m_mou_7 \			
8 4.08	0.58	0.10	22.43	
13 29.79	38.29	154.58	308.13	
16	78.64	6.33	18.68	
73.08 17	0.00	0.00	1.28	

0.00					
21	5.98	0.1	8	67.69	
38.23	3.30	011	o .	0,103	
		std_ic_t2f_mou_	6 std_ic_	_t2f_mou_7	
std_1c_t2 8	f_mou_8 \ 0.65	0.0	A	0.0	
0.00	0.05	0.0	O	0.0	
13	317.91	0.0	0	0.0	
1.91					
16	73.93	0.5	1	0.0	
2.18	0.00	0.0	0	0.0	
17 0.00	0.00	0.0	U	0.0	
21	101.74	0.0	Θ	0.0	
0.00	101171	0.10	•	0.0	
_	c_t2o_mou_6	std_ic_t2o_mou_	7 std_ic_	_t2o_mou_8	std_ic_mou_6
8	0.0	0	0	0.0	22 42
0	0.0	0.	U	0.0	22.43
13	0.0	0.	0	0.0	423.81
16	0.0	0.	0	0.0	87.99
17	0.0	0.	Θ	0.0	9.91
21	0.0	0.	Θ	0.0	81.76
ctd i	c mou 7 std	ic mou 0 total	ic mou 6	total_ic_	mou 7 \
8	4.66	_ic_mod_8 totat 0.75	103.86		28.49
13	68.09	474.41	968.61		72.58
16	151.73	82.44	364.86		81.56
17	0.00	0.00	91.88		2.31
21	44.21	101.93	207.09	1	31.89
		pl_ic_mou_6 spl	_ic_mou_7	spl_ic_mo	u_8
isd_ic_mo		0.00	0.0		0 0
8 0.00	16.54	0.00	0.0		0.0
13	1144.53	0.45	0.0		0.0
245.28	1111133	01 15	0.0		0.10
16	294.46	0.00	0.0	1	0.0
0.00					
17	0.00	0.00	0.0		0.0
0.00	261 04	0.00	0.0		0 0
21 0.00	261.04	0.00	0.0		0.0
0.00					

	isd_ic_mou_7	isd_ic_	mou_8 i	c_others_6	ic_others_7	ic_others_8
8	0.00		0.00	0.00	0.00	0.00
13	62.11	3	93.39	83.48	16.24	21.44
16	0.00		0.23	0.00	0.00	0.00
17	0.00		0.00	0.00	0.00	0.00
21	0.00		0.00	0.00	0.00	0.00
8 437 13 507 16 570 17 816 21		m_6 tot 19 6 10 19 22	al_rech_i	num_7 tota 21 4 6 2 26	al_rech_num_8 14 11 2 4	
600		t_7 tot	al_rech_a	amt_8 max	_rech_amt_6	max_rech_amt_7
8		601		120	90	154
13						
		253		717	110	110
16		253 348		717 160	110 110	110 110
16 17						
		348		160	110	110
17		348 0 680 8 last_ 0 0 0	day_rch_a	160 30 718	110 110 50 t_day_rch_amt_	110 0 50
17 21 8 13 16 17 21	max_rech_amt_8 30 130 130 30 50 last_day_rch_8 3g_mb_6 \	348 0 680 8 last_ 0 0 0 0	ol_2g_mb <sub>_</sub>	160 30 718 amt_6 last 50 110 100 30 30 30 _6 vol_2g	110 110 50 t_day_rch_amt_	110 0 50 -7 0 50 00 0

0 0					
0.0 16 0.0	1	.30 (	9.0	0.0	0.00
17		0 (	9.0	0.0	0.00
0.0 21 0.0		50 (	9.0	0.0	0.00
vol_3	g_mb_7 vol	3g_mb_8 mor	nthly_2g_6	monthly_2g_7	monthly_2g_8
	750.95	11.94	0	1	0
13	0.00	0.00	0	0	0
16	0.00	0.00	0	0	9
17	0.00	0.00	0	0	0
21	0.00	0.00	0	0	Θ
sache	et_2g_6 sac	het_2g_7 sac	chet_2g_8 m	nonthly_3g_6	monthly_3g_7
8	0	1	3	0	0
13	0	0	3	0	0
16	0	0	0	0	Θ
17	0	0	0	0	0
21	0	0	0	0	0
month		chet_3g_6 sa	achet_3g_7	sachet_3g_8	aon
8 21.03	0	0	0	0	315
13	0	0	0	0	2607
0.00 16	0	0	0	0	511
0.00 17	0	0	0	0	667
0.00	0	0	0	0	720
	bc_3g jun_ 10.65 0.00 2.45	vbc_3g avg_ 122.16 0.00 21.89	rech_amt_6_7 519.0 380.0 459.0	0 0	L_mou_good \ 612.22 1875.70 711.67

```
17
          0.00
                       0.00
                                         408.0
                                                    0
                                                               1341.41
21
          0.00
                       0.00
                                         640.0
                                                    0
                                                               1067.43
    avg mou action
                     diff mou
                                decrease mou action avg rech num action
\
8
           324.125
                     -288.095
                                                   1
                                                                      17.5
13
          1262.390
                     -613.310
                                                   1
                                                                       7.5
                                                                       4.0
16
           597.705
                     -113.965
                                                   1
17
              1.560 -1339.850
                                                   1
                                                                       3.0
21
          1245.130
                      177.700
                                                   0
                                                                      26.5
                    decrease rech num action
                                               avg rech amt action
    diff rech num
8
              -1.5
                                                               360.5
13
               1.5
                                            0
                                                               485.0
16
              -6.0
                                             1
                                                               254.0
                                             1
17
             -16.0
                                                                15.0
                                            0
                                                               699.0
21
               4.5
                    decrease rech amt_action avg_arpu_action
    diff rech amt
diff arpu
             -76.5
                                             1
                                                       314.7925
63.9285
13
             -22.0
                                                       399,4655
93.3805
                                             1
                                                       243.8815
16
            -316.0
187.0935
                                                        22.2395
17
           -801.0
667.7685
             99.0
                                                       617.7565
21
103.3035
    decrease arpu action
8
                        1
13
                        1
                        1
16
17
                        1
                        0
21
# VBC in action phase
data['avg_vbc_3g_action'] = (data['jul_vbc_3g'] +
data['aug_vbc_3g'])/2
# Difference of good and action phase VBC
data['diff vbc'] = data['avg vbc 3g action'] - data['jun vbc 3g']
```

```
# Checking whether the VBC has decreased on the action month
data['decrease vbc action'] = np.where(data['diff vbc'] < 0 , 1, 0)</pre>
data.head()
   mobile_number loc_og_t2o_mou std_og_t2o_mou loc_ic_t2o_mou
arpu 6 \
      7001524846
                              0.0
                                               0.0
                                                               0.0
378.721
                                                               0.0
13
      7002191713
                              0.0
                                               0.0
492.846
                              0.0
                                               0.0
                                                               0.0
      7000875565
430.975
      7000187447
                              0.0
                                               0.0
                                                               0.0
17
690.008
                              0.0
                                               0.0
                                                               0.0
21
      7002124215
514.453
     arpu 7
              arpu 8 onnet mou 6 onnet mou 7 onnet mou 8
offnet mou 6 \
    492.223 137.362
                            413.69
                                          351.03
                                                        35.08
94.66
                            501.76
13 205.671
             593,260
                                          108.39
                                                       534.24
413.31
            187.894
                             50.51
                                          74.01
                                                        70.61
16 299.869
296.29
                                                         7.79
17 18.980
              25.499
                           1185.91
                                            9.28
61.64
21 597.753
             637.760
                            102.41
                                          132.11
                                                        85.14
757.93
    offnet mou 7
                  offnet mou 8 roam ic mou 6 roam ic mou 7
roam ic mou 8 \
           80.63
8
                         136.48
                                          0.00
                                                          0.00
0.00
          119.28
                         482.46
                                          23.53
                                                        144.24
13
72.11
16
          229.74
                         162.76
                                          0.00
                                                          2.83
0.00
17
                                          0.00
                                                          4.76
            0.00
                           5.54
4.81
21
          896.68
                         983.39
                                          0.00
                                                          0.00
0.00
    roam_og_mou_6
                    roam_og_mou 7
                                   roam_og_mou_8
                                                   loc_og_t2t_mou_6 \
8
                             0.00
                                             0.00
             0.00
                                                             297.13
13
             7.98
                            35.26
                                             1.44
                                                              49.63
16
             0.00
                            17.74
                                             0.00
                                                              42.61
             0.00
                             8.46
                                                              38.99
17
                                            13.34
21
             0.00
                             0.00
                                             0.00
                                                               4.48
```

		loc_og_t2t_mou_8	loc_og_t2m_mou_6	
loc_6 8 70.58	og_t2m_mou_7 \ 217.59	12.49	80.96	
13 47.28	6.19	36.01	151.13	
16 145.	65.16	67.38	273.29	
17 0.00	0.00	0.00	58.54	
21 87.9	6.16	23.34	91.81	
loc_	og_t2f_mou_8 \	loc_og_t2f_mou_6		
8 0.00	50.54	0.00	0.00	
13 23.5	294.46 1	4.54	0.00	
16 10.2	128.28	0.00	4.48	
17 0.00	0.00	0.00	0.00	
21 1.58	104.81	0.75	0.00	
	loc_og_t2c_mou_6	loc_og_t2c_mou_7	loc_og_t2c_mou_8	loc_og_mou_6
8	0.0	0.0	7.15	378.09
13	0.0	0.0	0.49	205.31
16	0.0	0.0	0.00	315.91
17	0.0	0.0	0.00	97.54
21	0.0	0.0	0.00	97.04
8 13 16 17 21	loc_og_mou_7 loc 288.18 53.48 215.64 0.00 94.09	c_og_mou_8 std_og_ 63.04 353.99 205.93 0.00 129.74	t2t_mou_6 std_og_ 116.56 446.41 7.89 1146.91 97.93	t2t_mou_7 \ 133.43 85.98 2.58 0.81 125.94
std_	std_og_t2t_mou_8 og_t2m_mou_8 \		std_og_t2m_mou_7	
8	22.58	13.69	10.04	

75.69					
13 156.9	498	. 23	255.36	52.94	
150.9		. 23	22.99	64.51	
18.29			22.33	052	
17	0	. 00	1.55	0.00	
0.00	61	70	665 36	000 74	
21 876.9		. 79	665.36	808.74	
0/0.5	5				
			2f_mou_7 st	d_og_t2f_mou_8	
std_o 8	<del>-</del>	9.0	0.0	0.0	
0.0	ľ	9.0	0.0	0.0	
13	(	9.0	0.0	0.0	
0.0					
16	(	9.0	0.0	0.0	
0.0 17	(	9.0	0.0	0.0	
0.0	`	3.0	0.10	0.10	
21	(	9.0	0.0	0.0	
0.0					
S	td_og_t2c_mou	ı 7 std oa t	2c mou 8 st	d_og_mou_6 std	oa mou 7 \
8	(	9.0	0.0	130.26	143.48
13		9.0	0.0	701.78	138.93
16 17		9.0 9.0	0.0 0.0	30.89 1148.46	67.09 0.81
21		9.0	0.0	763.29	934.69
	td_og_mou_8 g mou 6 \	isd_og_mou_6	isd_og_mou	_7 isd_og_mou_	8
8 8	98.28	0.0	0	.0 0.0	9
0.00			_		
13	655.18	0.0	0	.0 1.2	9
0.00 16	21.53	0.0	O	.0 0.0	<b>a</b>
0.00	21.55	0.0	O	.0 0.0	O
17	0.00	0.0	0	.0 0.0	9
2.58	020.70	0.0	0	0 0 0	0
21 0.00	938.79	0.0	0	.0 0.0	ט
0.00					
	pl_og_mou_7	spl_og_mou_8	og_others_	6 og_others_7	og_others_8
8	0.00	10.23	0.0	0.0	0.0
J	0.00	10.23	0.0	0.0	0.0
13	0.00	4.78	0.0	0.0	0.0
1.0					
16	3.26	5.91	0.0	0.0	0.0

17	0.00	0.00	0.93	0.0	0.0
21	0.00	0.00	0.00	0.0	0.0
		0.00		0.10	0.0
	L_og_mou_6 to 2t mou 6 \	tal_og_mou_7 t	otal_og_	mou_8	
8	508.36	431.66	1	71.56	23.84
13	907.09	192.41	10	15.26	67.88
16	346.81	286.01	2	33.38	41.33
17	1249.53	0.81		0.00	34.54
21	860.34	1028.79	10	68.54	2.48
	ic_t2t_mou_7 2m_mou_7 \	loc_ic_t2t_mou_	8 loc_i	c_t2m_mou_6	
8	9.84	0.3	31	57.58	
13.98	7 50	E2 E	:0	142 00	
13 18.53	7.58	52.5	00	142.88	
16	71.44	28.8	39	226.81	
149.69 17	0.00	0.0	10	47.41	
2.31				1,111	
21	10.19	19.5	54	118.23	
74.63					
	2f_mou_8 \	loc_ic_t2f_mou_	6 loc_i	c_t2f_mou_7	
8	15.48	0.0	00	0.00	
0.00 13	195.18	4.8	31	0.00	
7.49	150 16			0.60	
16 32.71	150.16	8.7	1	8.68	
17	0.00	0.0	00	0.00	
0.00 21	129.16	4.6	:1	2.84	
10.39	129.10	4.0	) I	2.04	
			.c_mou_8	std_ic_t2t_r	_
8 13	81.43 215.58	23.83 26.11	15.79 255.26	1.	0.00 15.68
16	276.86	229.83	233.20		58.79
17	81.96	2.31	0.00		8.63

21	125.33	87.68	159.11		14.06
		std_ic_t2t_mou_8	std_ic_	_t2m_mou_6	
std_ic_t2 8	2m_mou_7 \ 0.58	0.10		22.43	
4.08 13	38.29	154.58		308.13	
29.79 16	78.64	6.33		18.68	
73.08 17		0.00			
0.00	0.00			1.28	
21 38.23	5.98	0.18		67.69	
		std_ic_t2f_mou_6	std_ic_	_t2f_mou_7	
8	2f_mou_8 \ 0.65	0.00		0.0	
0.00 13	317.91	0.00		0.0	
1.91 16	73.93	0.51		0.0	
2.18 17	0.00	0.00		0.0	
0.00 21	101.74	0.00		0.0	
0.00					
std_i	c_t2o_mou_6	std_ic_t2o_mou_7	std_ic_	_t2o_mou_8	std_ic_mou_6
8	0.0	0.0		0.0	22.43
13	0.0	0.0		0.0	423.81
16	0.0	0.0		0.0	87.99
17	0.0	0.0		0.0	9.91
21	0.0	0.0		0.0	81.76
c+d i	s may 7 std	ic may 0 total	ic mou 6	+o+ol ic	mou 7 \
8	4.66	0.75	ic_mou_6 103.86	total_ic_	28.49
13 16	68.09 151.73	474.41 82.44	968.61 364.86		172.58 381.56
17 21	0.00 44.21	0.00 101.93	91.88 207.09	1	2.31 131.89
total isd_ic_mo		ol_ic_mou_6 spl_	ic_mou_7	spl_ic_mc	ou_8

8	16.54	0.00	0.0	0.0
0.00	9 1144.53	0.45	0.0	0.0
245 16		0.00	0.0	0.0
0.00	9			
17 0.00	0.00 9	0.00	0.0	0.0
21 0.00	261.04 9	0.00	0.0	0.0
\	isd_ic_mou_7 is	d_ic_mou_8 ic_ot	hers_6 ic_others	_7 ic_others_8
8	0.00	0.00	0.00 0.	00 0.00
13	62.11	393.39	83.48 16.	24 21.44
16	0.00	0.23	0.00 0.	00 0.00
17	0.00	0.00	0.00 0.	00 0.00
21	0.00	0.00	0.00 0.	00 0.00
tota 8 437 13 507 16 570 17 816 21 600	total_rech_num_6 al_rech_amt_6 \ 19 6 10 19	2	4 6 2	_8 14 11 2 4 27
	total_rech_amt_7	total_rech_amt_	8 max_rech_amt_6	max_rech_amt_7
8	601	12	0 90	154
13	253	71	7 110	110
16	348	16	0 110	110
17	0	3	0 110	0
21	680	71	8 50	50
	max_rech_amt_8	last_day_rch_amt_	6 last_day_rch_a	mt_7 \

8 13 16 17 21		30 130 130 30 50	50 110 100 30 30	1	0 50 90 0 20
8 0.0 13	last_day_rch _3g_mb_6 \	n_amt_8 vol_2 10 0	g_mb_6 vol_2 0.0 0.0	g_mb_7 vol_2g 356.0 0.0	_mb_8 0.03 0.02
0.0 16 0.0 17 0.0		130	0.0	0.0	0.00
21	vol_3g_mb_7	50 vol_3g_mb_8	0.0 monthly_2g_6	0.0 monthly_2g_7	monthly_2g_8
8	750.95	11.94	9	1	0
13	0.00	0.00	9	0	0
16	0.00	0.00	0	0	0
17	0.00	0.00	0	0	Θ
21	0.00	0.00	0	0	0
\	sachet_2g_6			monthly_3g_6	
8	0	1	3	0	0
13	0	0	3	0	0
16	0	0	0	0	0
17	0	0	0	0	0
21	0	0	0	0	0
aug	monthly_3g_8 _vbc_3g \	3 sachet_3g_6	sachet_3g_7	sachet_3g_8	aon
8 21.0	6	0	0	0	315
13	6	0	0	0	2607

16		0	0	0	0	511
0.00		U	U	U	U	311
17		0	0	0	0	667
0.00 21		Θ	0	0	Θ	720
0.00		O	U	O	U	720
					4 - 4 - 7	
8 13 16 17 21	jul_vbc_3g 910.65 0.00 2.45 0.00 0.00	jun_vbc_3g 122.16 0.00 21.89 0.00 0.00	avg_recn_a	mt_6_7 churn 519.0 0 380.0 0 459.0 0 408.0 0		mou_good \ 612.22 1875.70 711.67 1341.41 1067.43
	avg_mou_act	cion diff_mo	u decrease	_mou_action	avg_red	ch_num_action
8	324	.125 -288.09	5	1		17.5
13	1262	.390 -613.31	9	1		7.5
16	597			1		4.0
10	397	.705 -115.90	)	1		4.0
17	1.	.560 -1339.850	9	1		3.0
21	1245	.130 177.70	9	0		26.5
	diff_rech_r	num decrease	_rech_num_a	ction avg_r	ech_amt_	_action \
8		1.5		1		360.5
13 16		L.5 5.0		0 1		485.0 254.0
17	- 16	5.0		1		15.0
21	2	1.5		0		699.0
	diff_rech_a	amt decrease	_rech_amt_a	ction avg_a	rpu_acti	on
8	, ,	5.5		1	314.79	)25 -
63.9					200 40	`EE
13 93.3		2.0		1	399.46	)55 -
16	-316	5.0		1	243.88	315 -
187. 17	0935 -803	۱ ۵		1	22.23	205
667.		1.0		1	22.23	995 -
21	99	0.0		0	617.75	665
103.	3035					
	decrease_a ease vbc ad		vg_vbc_3g_a	ction diff_	vbc	
8	case_vuc_a	1	46.	5.840 343.	680	

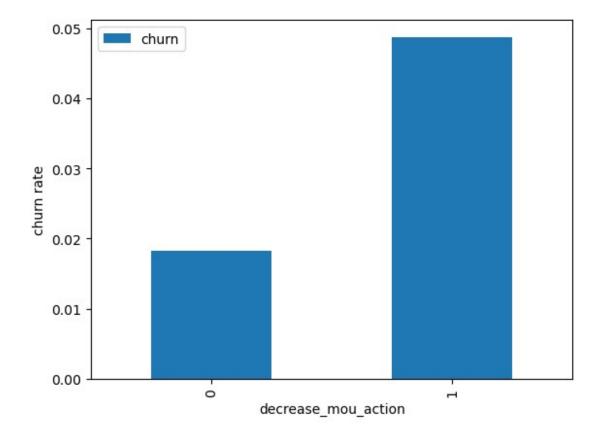
0				
13	1	0.000	0.000	
0				
16	1	1.225	-20.665	
1	_			
17	1	0.000	0.000	
0				
21	0	0.000	0.000	
0				

# EDA:

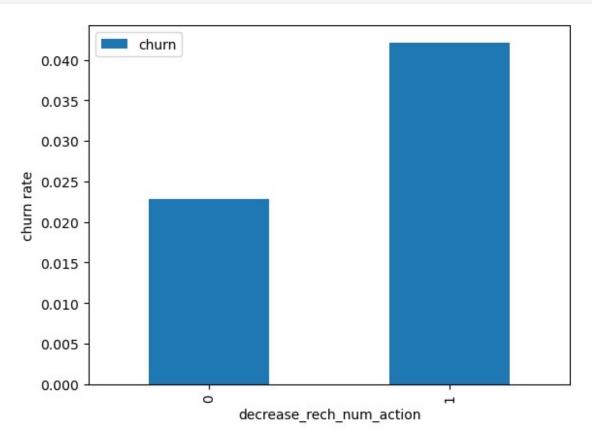
```
# Converting churn column to int in order to do aggfunc in the pivot
table
data['churn'] = data['churn'].astype('int64')
```

## Churn Rates:

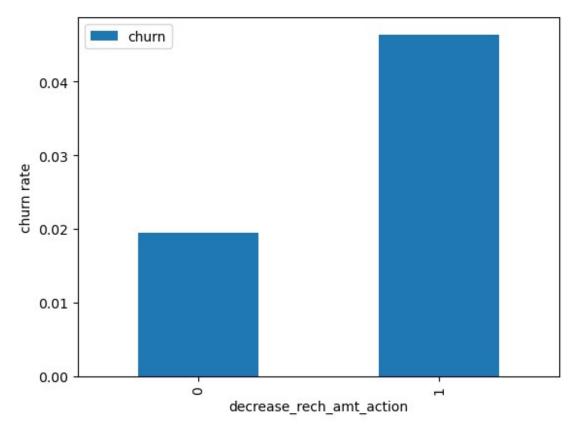
```
data.pivot_table(values='churn', index='decrease_mou_action',
aggfunc='mean').plot.bar()
plt.ylabel('churn rate')
plt.show()
```



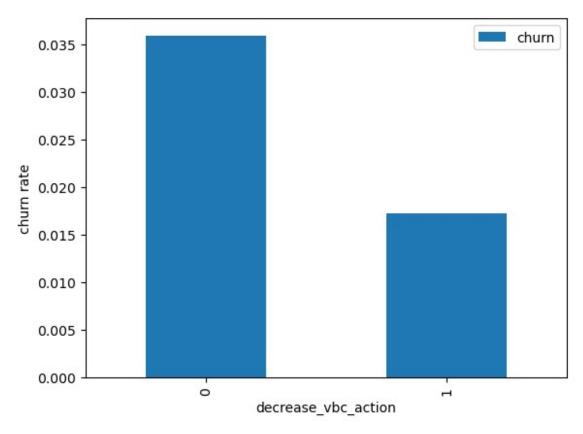
```
data.pivot_table(values='churn', index='decrease_rech_num_action',
   aggfunc='mean').plot.bar()
plt.ylabel('churn rate')
plt.show()
```



```
data.pivot_table(values='churn', index='decrease_rech_amt_action',
   aggfunc='mean').plot.bar()
plt.ylabel('churn rate')
plt.show()
```



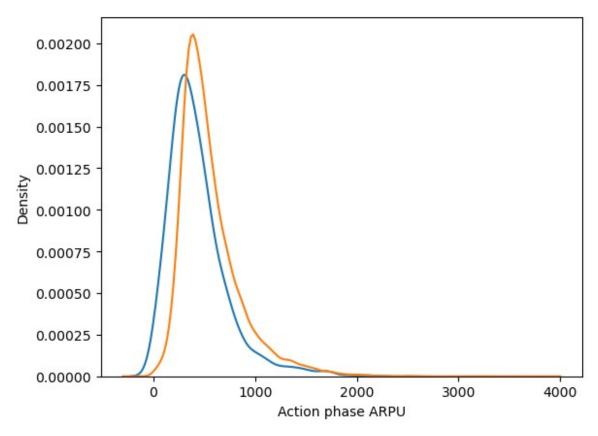
```
data.pivot_table(values='churn', index='decrease_vbc_action',
aggfunc='mean').plot.bar()
plt.ylabel('churn rate')
plt.show()
```



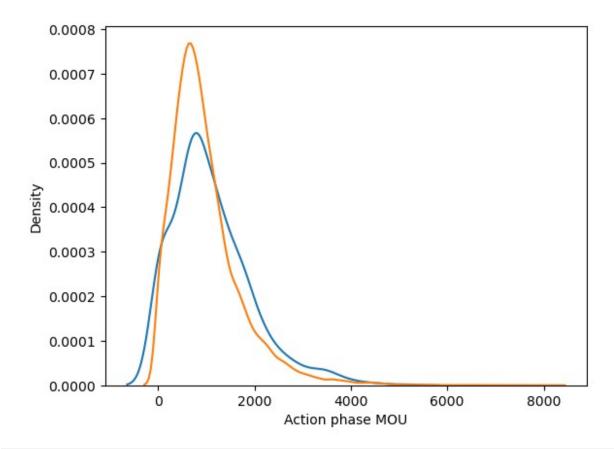
```
# Creating churn dataframe
data_churn = data[data['churn'] == 1]
# Creating not churn dataframe
data_non_churn = data[data['churn'] == 0]

# Distribution plot
ax =
sns.distplot(data_churn['avg_arpu_action'],label='churn',hist=False)
ax = sns.distplot(data_non_churn['avg_arpu_action'],label='not
churn',hist=False)
ax.set(xlabel='Action phase ARPU')

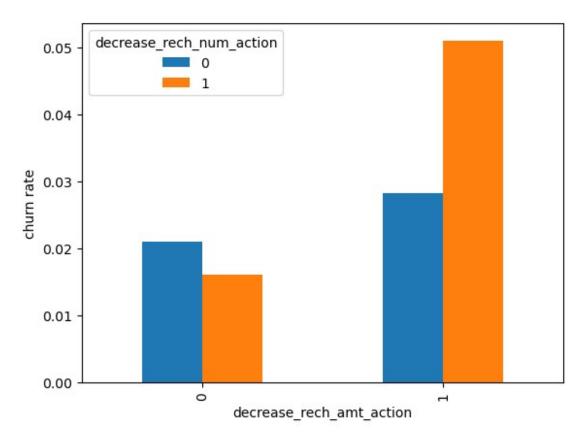
[Text(0.5, 0, 'Action phase ARPU')]
```



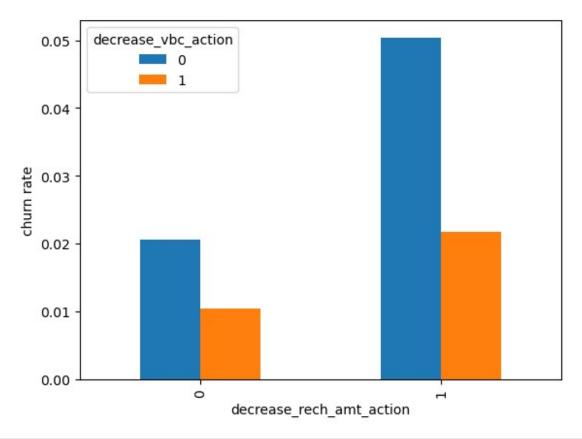
```
# Distribution plot
ax =
sns.distplot(data_churn['total_mou_good'],label='churn',hist=False)
ax = sns.distplot(data_non_churn['total_mou_good'],label='non
churn',hist=False)
ax.set(xlabel='Action phase MOU')
[Text(0.5, 0, 'Action phase MOU')]
```



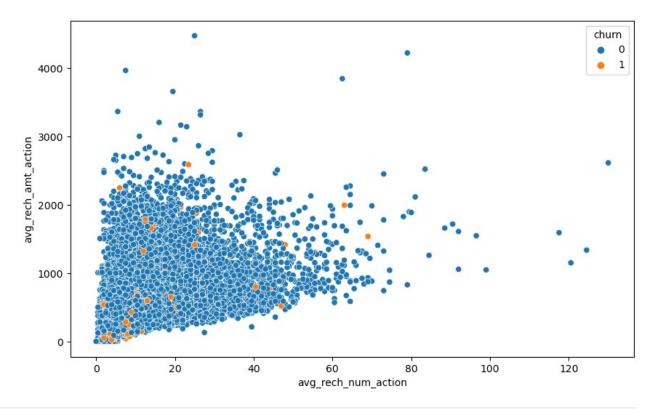
data.pivot\_table(values='churn', index='decrease\_rech\_amt\_action',
columns='decrease\_rech\_num\_action', aggfunc='mean').plot.bar()
plt.ylabel('churn rate')
plt.show()



```
data.pivot_table(values='churn', index='decrease_rech_amt_action',
columns='decrease_vbc_action', aggfunc='mean').plot.bar()
plt.ylabel('churn rate')
plt.show()
```



```
plt.figure(figsize=(10,6))
ax = sns.scatterplot('avg_rech_num_action','avg_rech_amt_action',
hue='churn', data=data)
```



```
data =
data.drop(['total_mou_good','avg_mou_action','diff_mou','avg_rech_num_
action','diff_rech_num','avg_rech_amt_action',

'diff_rech_amt','avg_arpu_action','diff_arpu','avg_vbc_3g_action','dif
f_vbc','avg_rech_amt_6_7'], axis=1)
```

## Train-Test Split:

```
# Import library
from sklearn.model_selection import train_test_split

# Putting feature variables into X
X = data.drop(['mobile_number','churn'], axis=1)

# Putting target variable to y
y = data['churn']

# Splitting data into train and test set 80:20
X_train, X_test, y_train, y_test = train_test_split(X, y, train_size=0.8, test_size=0.2, random_state=100)
```

## Feature Scaling:

```
# Standardization method
from sklearn.preprocessing import StandardScaler
```

```
# Instantiate the Scaler
scaler = StandardScaler()
# List of the numeric columns
cols scale = X train.columns.to list()
# Removing the derived binary columns
cols scale.remove('decrease mou action')
cols scale.remove('decrease rech num action')
cols scale.remove('decrease rech amt action')
cols scale.remove('decrease arpu action')
cols scale.remove('decrease vbc action')
# Fit the data into scaler and transform
X train[cols scale] = scaler.fit transform(X train[cols scale])
X train.head()
       loc og t2o mou std og t2o mou loc ic t2o mou
                                                          arpu 6
arpu 7
76637
                  0.0
                                   0.0
                                                   0.0 0.177042 -
0.565237
44417
                  0.0
                                   0.0
                                                   0.0 -1.385359
4.245131
77582
                  0.0
                                   0.0
                                                   0.0 -0.185183
0.470514
                  0.0
                                   0.0
48224
                                                   0.0 -0.871138
0.761096
                  0.0
                                   0.0
                                                   0.0 0.307153
76321
0.183378
         arpu 8
                 onnet mou 6 onnet mou 7 onnet mou 8
offnet mou 6 \
76637 -0.615403
                    0.342004
                                 -0.607254
                                              -0.528515
                                                            -0.153098
44417 2.814453
                   -0.542001
                                 -0.146232
                                              -0.118059
                                                            -0.772620
                                 -0.539126
77582
      0.439043
                   -0.475845
                                              -0.408638
                                                            -0.320016
48224
      0.363448
                   -0.592545
                                 -0.594671
                                              -0.522008
                                                            -0.787657
                                              -0.012023
76321
      0.873588
                   -0.192921
                                 -0.085344
                                                             1.064736
       offnet mou 7
                     offnet mou 8
                                    roam ic mou 6
                                                   roam ic mou 7 \
                                                        0.\overline{2}05784
          -0.662893
                         0.076469
                                        -0.226857
76637
44417
           2.703900
                         2.265268
                                        -0.226857
                                                       -0.174352
77582
          -0.513282
                        -0.236643
                                        -0.226857
                                                       -0.174352
48224
          -0.682141
                        -0.681495
                                        -0.226857
                                                       -0.174352
76321
           0.978616
                         0.927164
                                        -0.194707
                                                       -0.174352
       roam ic mou 8 roam og mou 6 roam og mou 7 roam og mou 8 \
```

76637 44417 77582 48224 76321	-0.080821 -0.177592 -0.177592 -0.177592 -0.177592	-0.262731 -0.262731 -0.262731 -0.262731 -0.113932	-0.231835 -0.231835 -0.231835 -0.231835 -0.231835	-0.199342 -0.222177 -0.222177 -0.222177 -0.222177	
loc_og_t2m	_mou_6 \	loc_og_t2t_mou_7			
76637 0.151967	-0.322715	-0.372360	-	0.354566	
44417 0.649268	-0.273693	0.081994	<u>-</u>	0.016667	-
77582 0.246349	-0.052711	-0.204119		0.005938	
48224	-0.266482	-0.270904	-	0.214459	-
0.524821 76321 0.891634	-0.012575	0.482944		0.632439	
loc_og_t2f		loc_og_t2m_mou_8	loc_og_t	2f_mou_6	
76637 0.340270	-0.420117	-0.642896	-	0.323654	-
44417	0.616324	-0.090497	-	0.338403	-
0.340270 77582	-0.061381	0.406662		0.989539	
0.206052 48224	-0.431653	-0.524363		0.248002	
0.027366					
76321 0.664664	0.527985	1.159083		0.462834	
		loc_og_t2c_mou_6	loc_og_t	2c_mou_7	
loc_og_t2c 76637	_mou_8 \ -0.332085	-0.221854		0.211338	-
0.248213 44417	-0.332085	-0.221854		0.211338	-
0.248213 77582	-0.247684	-0.221854	_	0.211338	
0.248213					
48224 2.084050	-0.332085	1.248293		2.109168	
76321 0.657101	0.237747	2.244788	-	0.211338	
76637 44417 77582	-0.126098 -0.614628 0.182883	-0.533371 -0. 0.419754 -0. -0.164394 0.	_mou_8 st 658333 087647 250207 492487	d_og_t2t_mou_6 0.613923 -0.418751 -0.478943 -0.480467	\

76321	0.596098	0.694210 1.	. 161870	-0.223093
std std og t2m		std_og_t2t_mou_8	8 std_og_t2m_mc	u_6
76637 0.424027	-0.439814	-0.371548	8 -0.185	- 381
44417 2.679038	-0.197208	-0.103563	3 -0.383	3541
77582 0.498443	-0.466869	-0.445767	7 -0.505	- 317
48224 0.506520	-0.488583	-0.445767	7 -0.516	751 -
76321 0.783843	-0.377256	-0.361596	0.629	0624
std std og t2f		std_og_t2f_mou_0	6 std_og_t2f_mc	u_7
76637 0.158073	0.497949	-0.163033	3 -0.158	- 3166
44417	2.668757	-0.163033	3 -0.158	- 3166
0.158073 77582	-0.452982	-0.163033	3 -0.158	- 166
0.119193 48224	-0.443640	-0.163033	3 -0.158	3166 -
0.158073 76321	0.413605	-0.163033	3 -0.158	3166 -
0.158073				
std_og_mou				_
76637 0.289420	0.0	0.0	9	0.0
44417 0.550271	0.0	0.0	9	0.0 -
77582 0.674185	0.0	0.0	9	0.0 -
48224 0.678920	0.0	0.0	9	0.0 -
76321 0.272238	0.0	0.0	9	0.0
	aa may 7 a+d		a mou 6 ded oa	may 7
isd_og_mou	_8 \		g_mou_6 isd_og_	
0.083560	-0.592755			.05549 -
44417 0.083560	1.713768	1.751601 -0	.095491 -0.1	.05549 -
77582 0.083560	-0.662370	-0.606634 -0	.095491 -0.6	59942 -
	-0.682604	-0.601006 -0	.095491 -0.1	.05549 -

0.083560					
76321	0.283579	0.040314	-0.095491	-0.105549	
0.056227					
		_	-		
	l_og_mou_6	spl_og_mou_7	spl_og_mou_8	3 og_others_6	
og_others		0 222220	0 110000	0 207007	
76637	-0.333192	-0.333239	-0.110669	0 -0.307087	-
0.021261 44417	0 222102	0 222220	0 222075	. 0 207007	
0.021261	-0.333192	-0.333239	-0.322875	-0.307087	-
77582	-0.333192	-0.187585	0.020521	-0.307087	
0.021261	-0.555152	-0.107303	0.020321	-0.507007	
48224	0.264222	0.579254	0.479916	6 -0.217152	_
0.021261	01201222	01373231	01175510	01217132	
76321	0.823369	-0.231599	-0.014003	-0.307087	_
0.021261					
		total_og_mou_6		ou_7 total_og_m	nou_8 \
	-0.019099	0.178334			
	-0.019099	-0.892633			86431
	-0.019099	-0.524717			
	-0.019099	-0.939094			
76321	-0.019099	0.632796	0.658	3928 0.67	3762
1.0	c ic +2+ mov	u 6 loc ic +2	+ may 7 loc	ic +2+ may 0	
	c_ic_t2t_mo m mou 6 \	u_0	t_mou_7 loc_	_1C_LZL_IIIOU_0	
76637	-0.266	ດ13 _ ຄ	.331719	-0.361200	_
0.505072	-0.200	915 -0	. 551719	-0.301200	_
44417	-0.422	316 0	.011236	-0.062530	_
0.585292	01122	0	1011230	01002330	
77582	-0.168	724 -0	.194188	-0.037712	-
0.035050					
48224	-0.311	961 -0	.347324	-0.292352	_
0.078351					
76321	-0.293	169 0	.227840	0.381658	-
0.426551					
_					
		u_7 loc_ic_t2	m_mou_8 loc_	_ic_t2f_mou_6	
	f_mou_7 \	202	CE0C20	0 240056	
76637	-0.458	302 -0	.658630	-0.348956	-
0.341145	0.244	107 0	105227	0 240056	
44417 0.341145	0.344	10/ -0	.105327	-0.348956	-
77582	-0.112	331 0	.122642	0.035354	
0.226783	-0.112.	001	122042	0.033334	-
48224	0.182	510 <sub>-</sub> 0	.386260	-0.348956	_
0.339548	0.102	-0	1300200	-0.040300	_
76321	0.0599	920 A	.151332	0.032724	
0.087562	01033		. 10 10 5	01032721	

```
loc ic t2f mou 8
                          loc ic mou 6
                                         loc ic mou 7
                                                        loc ic mou 8
76637
               -0.267723
                                            -0.550273
                                                           -0.689043
                              -0.546581
44417
               -0.347484
                              -0.684844
                                             0.189497
                                                           -0.156465
77582
               -0.032671
                              -0.108400
                                            -0.218631
                                                            0.061930
48224
               -0.342360
                              -0.270442
                                            -0.116039
                                                           -0.472536
76321
               -0.072552
                             -0.449208
                                             0.178701
                                                            0.294310
       std ic t2t mou 6
                          std ic t2t mou 7 std ic t2t mou 8
std ic t2m mou 6 \
76637
               -0.161028
                                  -0.154808
                                                     -0.015655
0.155433
44417
                                  -0.191149
               -0.201883
                                                     -0.156852
0.313283
77582
               -0.201883
                                  -0.191149
                                                     -0.211830
0.318368
48224
               -0.201883
                                  -0.191149
                                                     -0.211830
0.318368
76321
               -0.201883
                                  -0.191149
                                                      0.006309
0.074465
       std ic t2m mou 7
                          std ic t2m mou 8 std ic t2f mou 6
std ic t2f mou 7 \
76637
               0.245509
                                  -0.193470
                                                     -0.151088
0.154416
44417
               0.030736
                                  -0.127395
                                                     -0.151088
0.154416
77582
               -0.257341
                                  -0.273050
                                                     -0.151088
0.154416
48224
                                  -0.282889
               -0.327187
                                                     -0.151088
0.154416
76321
               0.834605
                                  -0.029874
                                                      0.007922
0.103470
       std ic t2f mou 8
                          std ic t2o mou 6
                                             std ic t2o mou 7
std ic t2o mou 8 \
              -0.145034
                                        0.0
                                                           0.0
76637
0.0
                                                           0.0
44417
               -0.145034
                                        0.0
0.0
               -0.144498
                                                           0.0
77582
                                        0.0
0.0
                                        0.0
                                                           0.0
48224
               -0.145034
0.0
76321
                                                           0.0
               -0.007858
                                        0.0
0.0
       std ic mou 6
                      std ic mou 7
                                     std ic mou 8
                                                   total_ic_mou_6 \
          -0.223572
76637
                          0.054576
                                        -0.171473
                                                         -0.595060
44417
          -0.360033
                         -0.113938
                                        -0.196568
                                                         -0.768527
77582
          -0.363680
                         -0.310730
                                        -0.333660
                                                         -0.266815
```

```
48224
                         -0.358443
                                        -0.341045
          -0.363680
                                                         -0.410121
76321
          -0.166785
                          0.441950
                                        -0.019826
                                                         -0.295689
       total ic mou 7
                        total ic mou 8
                                         spl_ic mou 6
                                                       spl ic mou 7 \
                                                           -0.091097
76637
            -0.488322
                             -0.695983
                                             -0.32758
44417
             0.081383
                             -0.246180
                                             -0.32758
                                                           -0.091097
77582
                                             -0.32758
            -0.341971
                             -0.110566
                                                           -0.091097
48224
            -0.280073
                             -0.574504
                                             -0.32758
                                                            0.692876
76321
             1.535642
                              1.476830
                                             -0.32758
                                                           -0.091097
       spl ic mou 8 isd ic mou 6 isd ic mou 7 isd ic mou 8
ic others 6 \
          -0.253722
                         -0.159145
                                        -0.165185
76637
                                                      -0.160355
0.095128
          -0.253722
                         -0.159145
44417
                                        -0.165185
                                                      -0.160355
0.095128
                         -0.145254
                                        -0.125510
                                                      -0.160355
77582
          -0.253722
0.095128
48224
          -0.253722
                         -0.159145
                                        -0.165185
                                                       -0.160355
0.095128
76321
          -0.253722
                          0.764862
                                         3.091804
                                                       3.285291
0.524591
                                  total rech num 6
       ic others 7
                     ic others 8
                                                     total rech num 7 \
         -0.122138
76637
                       -0.106000
                                           0.217883
                                                             -0.419014
44417
         -0.122138
                       -0.106000
                                          -0.644063
                                                              3.712370
77582
         -0.122138
                       -0.106000
                                          -0.644063
                                                             -0.313081
48224
         -0.122138
                       -0.106000
                                          -0.213090
                                                              0.322516
76321
         19.878070
                       18.102019
                                          -0.644063
                                                             -0.207148
       total rech num 8 total rech amt 6 total rech amt 7
total rech amt 8 \
76637
               0.044523
                                  0.088303
                                                    -0.769872
0.570923
44417
               2.282402
                                  -1.310958
                                                     3.958327
2.877251
77582
               -0.381740
                                  -0.065373
                                                     0.654316
0.398380
48224
               0.257654
                                  -0.895763
                                                     0.620468
0.427890
76321
               0.257654
                                  -0.321500
                                                     0.112760
0.834225
       max rech amt 6
                      max rech amt 7 max rech amt 8
last day rch amt 6 \
76637
            -0.079749
                             -0.107353
                                              -0.222292
0.423106
44417
            -0.753512
                                              -0.294618
                             -0.455738
0.408602
77582
            -0.092706
                             -0.107353
                                              -0.077638
```

0.151202 48224	-0.07974	9 0.524	1002 0 1	579877	
0.568546	-0.07374	0.524	1902 01.	379077	
76321	-0.30001	8 -0.262	.191 -0.3	222292	
0.151202					
la vol_2g_mb		amt_7 last_da	y_rch_amt_8	vol_2g_mb_6	
$766\overline{3}7$ 0.454756		13590	-0.745726	-0.158283	
44417 0.276447	-0.4	23604	-0.275080	-0.283744	-
77582 0.118274	0.2	00372	0.257291	-0.144907	-
48224 0.123234	-0.5	79599	-0.514261	-0.129650	-
76321	0.2	00372	0.257291	-0.283744	-
0.276447					
vo monthly_2		vol_3g_mb_6 v	ol_3g_mb_7 v	ol_3g_mb_8	
76637 2.284614	1.244475	0.328358	0.848931	-0.329023	
44417 0.340791	-0.259105	-0.324930	-0.349768	-0.335270	-
77582 0.340791	-0.018957	0.700229	1.490995	1.117469	-
48224 2.284614	-0.120329	2.102341	4.551937	2.878366	
76321 0.340791	-0.259105	-0.324930	-0.349768	-0.335270	-
	nthly_2g_7	monthly_2g_8	sachet_2g_6	sachet_2g_7	
	_8 \ 2.178305	-0.328849	3.204652	1.773057	
1.745129 44417	-0.348515	-0.328849	-0.299208	-0.317626	-
0.338422 77582	2.178305	-0.328849	0.284769	0.727716	
0.703354 48224	-0.348515	-0.328849	-0.299208	-0.317626	-
0.338422 76321 0.338422	-0.348515	-0.328849	-0.299208	-0.317626	-
	nthly 3g 6	monthly 3g 7	monthly 3g 8	sachet 3g 6	
sachet_3g	_7 \	7_ 5_	7_ 0_		
76637 0.160519	-0.298681	-0.300081	-0.301197	-0.16188	-
44417	-0.298681	-0.300081	-0.301197	-0.16188	-

```
0.160519
          -0.298681
                         -0.300081
                                       -0.301197
                                                       1.03250
77582
1.988521
48224
           1.584129
                          6.695454
                                        3.281161
                                                      -0.16188
0.160519
76321
          -0.298681
                         -0.300081
                                       -0.301197
                                                      -0.16188
0.160519
       sachet 3g 8
                               aug_vbc_3g
                                           jul_vbc_3g
                                                        jun_vbc_3g \
                          aon
76637
         -0.146661 -0.509556
                                -0.324997
                                            -0.338332
                                                         -0.032583
44417
         -0.146661 -0.884874
                                -0.339808
                                            -0.338332
                                                         -0.317058
77582
          1.820414 1.181411
                                 2.342626
                                             1.965731
                                                          1.189782
         -0.146661 -1.025617
48224
                                -0.339808
                                             -0.338332
                                                         -0.317058
76321
         -0.146661 -0.648260
                                -0.339808
                                            -0.338332
                                                       -0.317058
       decrease mou action decrease rech num action \
76637
                          1
                                                     1
                          0
                                                     0
44417
77582
                          1
                                                     0
                          0
                                                     0
48224
76321
                          0
                                                     0
       decrease rech amt action decrease arpu action
decrease vbc action
76637
                               1
                                                      1
1
44417
                               0
                                                      0
0
77582
                               0
                                                      0
                               0
                                                      0
48224
0
76321
                               0
                                                      0
# Transform the test set
X_test[cols_scale] = scaler.transform(X_test[cols_scale])
X test.head()
       loc og t2o mou std og t2o mou loc ic t2o mou arpu 6
arpu 7 \
5704
                  0.0
                                   0.0
                                                    0.0 0.280204 -
0.318483
                  0.0
                                   0.0
64892
                                                    0.0 0.084955 -
0.814767
                  0.0
                                   0.0
                                                    0.0 0.580284
39613
0.121878
93118
                  0.0
                                   0.0
                                                    0.0 0.675978
0.736183
81235
                  0.0
                                   0.0
                                                    0.0 3.901497
```

```
0.828475
          arpu 8
                   onnet mou 6 onnet mou 7 onnet mou 8
offnet mou 6 \
       0.630203
                     -0.619183
                                    -0.637742
                                                                   0.608858
5704
                                                  -0.538175
64892 -0.500458
                                                  -0.560938
                     -0.629329
                                    -0.646247
                                                                  -0.314708
                     -0.401743
39613 1.016326
                                    -0.455056
                                                  -0.298176
                                                                   0.840667
93118 -0.551999
                      0.150901
                                     0.142507
                                                  -0.252783
                                                                  -0.083998
81235 2.319996
                      4.977103
                                     1.683836
                                                   2.385666
                                                                   0.075648
                                       roam ic mou 6
        offnet mou 7
                       offnet mou 8
                                                        roam ic mou 7 ∖
                            1.\overline{8}951\overline{0}3
5704
            0.342453
                                             0.019810
                                                             -0.174352
64892
           -0.600361
                           -0.443135
                                             0.159624
                                                             -0.174352
39613
            0.478537
                            1.116829
                                            -0.226857
                                                             -0.174352
93118
           -0.137735
                           -0.583408
                                            -0.226857
                                                             -0.174352
81235
           -0.294198
                           -0.184465
                                            -0.226857
                                                             -0.174352
        roam ic mou 8
                         roam og mou 6
                                         roam og mou 7
                                                          roam og mou 8 \
            -0.\overline{177592}
                              0.\overline{5}204\overline{8}1
                                              -0.\overline{2}318\overline{3}5
                                                               -0.\overline{2}221\overline{7}7
5704
64892
            -0.177592
                                                               -0.222177
                              0.011124
                                              -0.231835
            -0.177592
39613
                             -0.262731
                                              -0.231835
                                                               -0.222177
93118
            -0.177592
                             -0.262731
                                              -0.231835
                                                               -0.222177
81235
             0.241661
                             -0.262731
                                              -0.231835
                                                                2.143657
        loc_og_t2t_mou_6 loc_og_t2t_mou_7 loc_og_t2t_mou_8
loc og t2m mou 6 \
5704
               -0.334519
                                    -0.349792
                                                        -0.245889
0.209155
                -0.334648
                                    -0.365370
                                                        -0.296837
64892
0.468284
39613
                0.087099
                                    -0.015188
                                                         0.220683
1.974621
93118
                0.576025
                                     0.653102
                                                         0.001547
0.456342
81235
                2.172569
                                     0.096374
                                                         0.857835
0.374053
        loc og t2m mou 7 loc og t2m mou 8 loc og t2f mou 6
loc og t2f mou 7 \setminus
5704
               -0.262736
                                    -0.295046
                                                        -0.195189
0.340270
                -0.430786
                                    -0.559971
64892
                                                        -0.327460
0.340270
39613
                1.479252
                                     2.682818
                                                        -0.120014
0.195175
```

93118	0.302126	-0.415625	1.137035	
0.859212 81235	0.163610	0.273982	-0.124772	
0.340270	0.103010	0.2/3902	-0.124//2	-
0.540270				
loc	_og_t2f_mou_8	loc_og_t2c_mou_6 1	loc_og_t2c_mou_7	
loc_og_t2c				
5704	-0.332085	0.060650	-0.211338	-
0.248213	0 222005	0 221054	0.211220	
64892 0.248213	-0.332085	-0.221854	-0.211338	-
39613	0.725617	-0.221854	-0.211338	
0.248213	0.723017	-0.221034	-0.211550	_
93118	0.329467	-0.221854	-0.211338	-
0.248213				
81235	-0.332085	-0.221854	-0.211338	-
0.248213				
1	C 1	7 1	0	
		_og_mou_7		\
		-0.535317 -0.568		
39613	1.327579	0.900113 1.901		
93118	0.728515	0.679835 -0.246		
81235	1.621196	0.147433 0.706	5861 4.343952	
		-1.1 121 0		
std og t2m	_og_t2t_mou_7	std_og_t2t_mou_8 s	std_og_t2m_mou_6	
5704	-0.488583	-0.445767	0.617438	
0.545049	01100303	01113707	01017 130	
64892	-0.488583	-0.441893	-0.056616	-
0.349636				
39613	-0.488583	-0.445767	-0.246652	-
0.245338 93118	0 222510	0 266714	0 270266	
0.315896	-0.223518	-0.266714	-0.378266	-
81235	1.878690	1.811176	-0.093858	_
0.347210	11070030	11011170	0.033030	
	_og_t2m_mou_8	std_og_t2f_mou_6	std_og_t2f_mou_7	
std_og_t2f				
5704	2.325447	-0.163033	-0.158166	-
0.158073	0 117700	0 162022	0 150166	
64892 0.146841	-0.117788	-0.163033	-0.158166	-
39613	-0.240062	0.877452	-0.158166	_
0.158073	31210002	0.077132	3.133100	
93118	-0.390018	-0.163033	-0.158166	-
0.158073				
81235	-0.438810	-0.163033	-0.158166	-
0.158073				

```
std og mou 6
5704
                    0.0
                                      0.0
                                                         0.0
0.096043
64892
                    0.0
                                      0.0
                                                         0.0
0.370111
                    0.0
                                      0.0
                                                         0.0
39613
0.476234
                    0.0
                                      0.0
                                                         0.0
93118
0.365215
81235
                    0.0
                                      0.0
                                                         0.0
2.897919
       std og mou 7
                     std og mou 8
                                   isd og mou 6 isd og mou 7
isd og mou 8 \
5704
           0.043595
                         1.290694
                                      -0.095491
                                                     -0.105549
0.08356
64892
          -0.574262
                        -0.375602
                                      -0.095491
                                                     -0.105549
0.08356
39613
          -0.502235
                        -0.461931
                                      -0.095491
                                                     -0.105549
0.08356
                        -0.445935
93118
          -0.372235
                                      -0.095491
                                                     -0.105549
0.08356
81235
           1.023481
                         0.895212
                                      -0.095491
                                                     -0.105549
0.08356
       spl og mou 6
                     spl og mou 7
                                   spl og mou 8
                                                  og others 6
og others 7
5704
           0.961014
                         0.702674
                                       0.491423
                                                     0.277486
0.021261
          -0.314344
                        -0.333239
                                      -0.322875
                                                    -0.307087
64892
0.021261
39613
          -0.333192
                        -0.333239
                                      -0.322875
                                                    -0.307087
0.021261
          -0.269795
                        -0.270168
                                      -0.277304
93118
                                                    -0.023794
0.021261
81235
           0.032909
                        -0.333239
                                      -0.322875
                                                    -0.307087
0.021261
       og others 8
                    total og mou 6
                                    total og mou 7
                                                     total og mou 8 \
5704
         -0.019099
                         -0.102091
                                          -0.180668
                                                           0.990936
         -0.019099
                         -0.677933
                                          -0.862246
                                                          -0.666258
64892
39613
         -0.019099
                          0.350399
                                           0.038799
                                                           0.607679
93118
         -0.019099
                          0.093527
                                          0.034876
                                                          -0.552663
81235
         -0.019099
                          3.654782
                                          1.030999
                                                           1.190698
       loc ic t2t mou 6 loc ic t2t mou 7 loc ic t2t mou 8
loc ic t2m mou 6 \
5704
              -0.381893
                                -0.203679
                                                    0.031197
```

0.132443 64892	-0.194737	-0.392042	-0.319817	
0.096598 39613	-0.057041	-0.362172	-0.277572	-
0.292883 93118	1.565994	1.120165	0.702190	
0.490441 81235	0.065999	0.187198	-0.094552	
0.734727	ic +2m mou 7	loc ic t2m mou 8	loc ic +2f mou 6	
loc ic t2f		toc_rc_tzm_mou_o	toc_1c_t21_iiiou_0	
570 <del>4</del> – – – – – – – – – – – – – – – – – – –	-0.332588	0.101421	-0.348956	-
64892 0.331166	-0.086155	-0.117805	-0.337995	-
39613 0.323382	-0.502505	-0.295910	-0.209964	-
93118	0.385202	0.108161	-0.163926	-
0.079091 81235 0.184272	0.302005	0.090765	-0.268279	-
loc_ 5704 64892	ic_t2f_mou_8 -0.300474 -0.330775	-0.3457 <del>7</del> 6 -	ic_mou_7 loc_ic_mou_8 0.393827 0.044328 0.324380 -0.296514	\
39613 93118 81235	-0.249231 0.047090 -0.347484	-0.266447 - 1.146405	0.324380       -0.290314         0.594119       -0.388014         0.860483       0.447737         0.280662       -0.035266	
93118 81235 std_	-0.249231 0.047090 -0.347484 _ic_t2t_mou_6	-0.266447 - 1.146405 0.510931	0.594119 -0.388014 0.860483 0.447737	
93118 81235 std_ic_t2m_ 5704	-0.249231 0.047090 -0.347484 _ic_t2t_mou_6	-0.266447 - 1.146405 0.510931	0.594119       -0.388014         0.860483       0.447737         0.280662       -0.035266	
93118 81235 std_ic_t2m_ 5704 0.074310 64892	-0.249231 0.047090 -0.347484 _ic_t2t_mou_6 _mou_6 \	-0.266447 - 1.146405 0.510931 std_ic_t2t_mou_7	0.594119 -0.388014 0.860483 0.447737 0.280662 -0.035266 std_ic_t2t_mou_8	
93118 81235 std_ic_t2m_ 5704 0.074310 64892 2.450522 39613	-0.249231 0.047090 -0.347484 _ic_t2t_mou_6 _mou_6 \ -0.201883	-0.266447 - 1.146405 0.510931  std_ic_t2t_mou_7 -0.191149	0.594119 -0.388014 0.860483 0.447737 0.280662 -0.035266 std_ic_t2t_mou_8 -0.211830	
93118 81235 std_ic_t2m_ 5704 0.074310 64892 2.450522	-0.249231 0.047090 -0.347484 _ic_t2t_mou_6 _mou_6 \ -0.201883 -0.201883	-0.266447 - 1.146405 0.510931  std_ic_t2t_mou_7 -0.191149 -0.147833	0.594119 -0.388014 0.860483 0.447737 0.280662 -0.035266 std_ic_t2t_mou_8 -0.211830 0.037686	-
93118 81235 std_ic_t2m_ 5704 0.074310 64892 2.450522 39613 0.177371 93118	-0.249231 0.047090 -0.347484 ic_t2t_mou_6 mou_6 -0.201883 -0.201883	-0.266447 - 1.146405 0.510931  std_ic_t2t_mou_7 -0.191149 -0.147833 -0.191149	0.594119 -0.388014 0.860483 0.447737 0.280662 -0.035266 std_ic_t2t_mou_8 -0.211830 0.037686 -0.211830	
93118 81235 std_ic_t2m_ 5704 0.074310 64892 2.450522 39613 0.177371 93118 0.201302 81235 0.236203	-0.249231 0.047090 -0.347484 ic_t2t_mou_6 mou_6 \ -0.201883 -0.201883 -0.127109 3.734627 ic_t2m_mou_7	-0.266447 1.146405 0.510931 std_ic_t2t_mou_7 -0.191149 -0.147833 -0.191149 -0.120493 1.989978	0.594119 -0.388014 0.860483 0.447737 0.280662 -0.035266 std_ic_t2t_mou_8 -0.211830 0.037686 -0.211830 -0.150713	
93118 81235 std_ic_t2m_ 5704 0.074310 64892 2.450522 39613 0.177371 93118 0.201302 81235 0.236203 std_ic_t2f_ 5704	-0.249231 0.047090 -0.347484 ic_t2t_mou_6 mou_6 \ -0.201883 -0.201883 -0.127109 3.734627 ic_t2m_mou_7	-0.266447 1.146405 0.510931 std_ic_t2t_mou_7 -0.191149 -0.147833 -0.191149 -0.120493 1.989978	0.594119 -0.388014 0.860483 0.447737 0.280662 -0.035266 std_ic_t2t_mou_8 -0.211830 0.037686 -0.211830 -0.150713 3.309777	
93118 81235 std_ic_t2m_ 5704 0.074310 64892 2.450522 39613 0.177371 93118 0.201302 81235 0.236203 std_ic_t2f_	-0.249231 0.047090 -0.347484 _ic_t2t_mou_6 _mou_6 -0.201883 -0.201883 -0.127109 3.734627 _ic_t2m_mou_7 _mou_7	-0.266447 1.146405 0.510931 std_ic_t2t_mou_7 -0.191149 -0.147833 -0.191149 -0.120493 1.989978 std_ic_t2m_mou_8	0.594119	

```
0.154416
                                   -0.290413
93118
               -0.276309
                                                      -0.151088
0.154416
81235
               -0.276605
                                   -0.285108
                                                      -0.151088
0.154416
                           std_ic_t2o_mou_6 std_ic_t2o_mou_7
       std ic t2f mou 8
std ic t2o mou 8 \
                                         0.0
5704
               -0.145034
                                                             0.0
0.0
64892
                0.720886
                                         0.0
                                                             0.0
0.0
39613
               -0.145034
                                         0.0
                                                             0.0
0.0
                                         0.0
                                                             0.0
93118
               -0.145034
0.0
81235
               -0.145034
                                         0.0
                                                             0.0
0.0
       std ic mou 6
                       std ic mou 7
                                      std ic mou 8
                                                     total ic mou 6 \
                          -0.\overline{271250}
                                         -0.\overline{3}036\overline{17}
5704
           -0.082033
                                                           -0.365356
                           1.360917
64892
            1.733010
                                          1.351592
                                                            0.636557
39613
           -0.220925
                          -0.324159
                                         -0.355027
                                                           -0.350807
93118
           -0.237232
                          -0.281305
                                         -0.314516
                                                            0.884028
81235
            1.928118
                           0.984408
                                          1.508258
                                                            1.164932
       total ic mou 7
                         total ic mou 8
                                          spl ic mou 6
                                                         spl ic mou 7 \
5704
             -0.421554
                              -0.114210
                                               -0.32758
                                                             -0.091097
64892
              0.357025
                               0.239376
                                               -0.32758
                                                             -0.091097
             -0.678777
                                               -0.32758
                                                             -0.091097
39613
                              -0.505344
93118
              0.592237
                               0.229602
                                               -0.32758
                                                             -0.091097
81235
              0.602767
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                                                             -0.091097
       spl ic mou 8
                      isd ic mou 6 isd ic mou 7 isd ic mou 8
ic others 6 \
5704
           -0.253722
                          -0.159145
                                          0.158481
                                                         -0.160355
0.095128
           -0.253722
                                                         -0.160355
64892
                           0.182316
                                         -0.067598
0.058726
           -0.253722
                          -0.159145
                                         -0.165185
                                                         -0.160355
39613
0.095128
93118
           -0.253722
                          -0.082219
                                         -0.165185
                                                         -0.160355
0.095128
81235
           -0.253722
                          -0.159145
                                         -0.165185
                                                        -0.160355
0.095128
                                   total rech num 6
                                                       total rech num 7 \
       ic others 7
                     ic others 8
          -0.122138
                                           -0.105347
                                                                0.216583
5704
                        -0.106000
64892
           3.356552
                         0.217399
                                            0.002397
                                                               -0.630880
39613
          -0.122138
                        -0.055442
                                            -0.644063
                                                               -0.948679
```

93118 81235	-0.122138 -0.122138	-0.106000 -0.106000		544063 403060	0.004717 0.004717
total_red 5704	otal_rech_num ch_amt_8 \ 0.8970	_	ech_amt_6 t 0.131441	total_rech_amt 0.2908-	
0.441510 64892	-0.1686		0.104480	-0.7334	
0.393860 39613 0.863736	-0.8080	03	0.463057	-0.5667	89
93118 0.836516	-0.5948		1.164036	0.5657	
81235 2.734239	0.2576	54	3.784618	0.6152	61
last_day_	ax_rech_amt_6 _rch_amt_6 \		amt_7 max_r		
5704 0.071230	-0.079749		75094	-0.222292	
64892 0.568546 39613	-0.079749 1.896189	-	76516 60379	0.224819 1.940933	-
2.862251 93118	0.866109		11999	0.566726	
1.190837 81235 0.071230	0.555142	-0.12	20256	1.224242	
la vol 2g mb		mt_7 last_c	day_rch_amt_	_8 vol_2g_mb_	6
5704 1.615419	0.18	4772	-0.51426	2.66337	0
64892 5.231577	-0.42		-0.74572		
39613 0.276447 93118	2.76 1.13		2.34047		
0.276447 81235 2.091568	-0.42		0.79737		
vo monthly 2		ol_3g_mb_6	vol_3g_mb_7	7 vol_3g_mb_8	
5704 2.284614	-0.174947	-0.324930	-0.178911	l 0.236482	
64892 4.910020	3.280065	1.346894	0.097599		
39613 0.340791	-0.259105	-0.324930	-0.349768	3 -0.335270	-

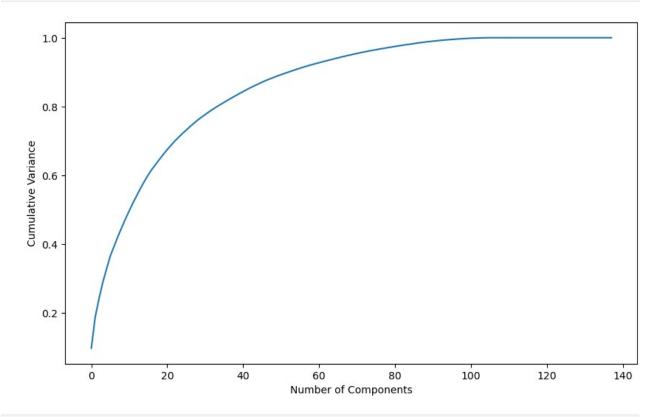
```
93118
         -0.259105
                       -0.324930
                                     -0.349768
                                                   -0.335270
0.340791
81235
          1.427774
                        -0.324930
                                     -0.349768
                                                   -0.335270
0.340791
                      monthly_2g_8
                                     sachet_2g_6
       monthly 2g 7
                                                   sachet 2g 7
sachet_2g_8
                          -0.328849
5704
          -0.348515
                                        0.284769
                                                       1.773057
1.745129
                          2.381677
                                        -0.299208
                                                      -0.317626
64892
           2.178305
1.745129
                          -0.328849
                                        -0.299208
39613
          -0.348515
                                                      -0.317626
0.338422
93118
          -0.348515
                          -0.328849
                                        -0.299208
                                                      -0.317626
0.338422
81235
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                                        1.452722
                                                       0.727716
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       monthly 3g 6
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                                     monthly 3g 8
                                                    sachet 3g 6
sachet 3g 7
5704
          -0.298681
                          -0.300081
                                         -0.301197
                                                         1.03250
0.914001
                          -0.300081
64892
          -0.298681
                                         -0.301197
                                                        -0.16188
0.160519
                          -0.300081
                                         -0.301197
39613
          -0.298681
                                                        -0.16188
0.160519
93118
          -0.298681
                          -0.300081
                                         -0.301197
                                                        -0.16188
0.160519
81235
                          -0.300081
                                          1.489982
           1.584129
                                                         2.22688
1.988521
                                             jul vbc 3g
       sachet 3g 8
                                aug vbc 3g
                                                          jun vbc 3g
                           aon
                                 -0.133609
                                                           -0.317058
5704
          1.820414
                     0.003445
                                               0.020306
                                               1.705824
64892
          -0.146661
                     0.351226
                                  1.677391
                                                            4.389368
39613
          -0.146661
                     2.402212
                                 -0.339808
                                              -0.338332
                                                           -0.317058
93118
          -0.146661
                     1.331334
                                 -0.339808
                                              -0.338332
                                                           -0.317058
81235
          0.836877 -0.407568
                                 -0.339808
                                              -0.338332
                                                           -0.317058
       decrease mou action
                              decrease rech num action
5704
                                                       0
64892
                          1
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39613
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93118
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       decrease rech amt action
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5704
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64892
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```

```
1
39613
0
0
93118
1
1
81235
1
1
1
```

#### Model With PCA:

```
#Import PCA
from sklearn.decomposition import PCA
# Instantiate PCA
pca = PCA(random state=42)
# Fit train set on PCA
pca.fit(X train)
PCA(random state=42)
# Principal components
pca.components
array([[-3.20564485e-19, 1.11022302e-16, -0.00000000e+00, ...,
        -1.07346345e-02, -9.68482451e-03, 9.99904011e-03],
       [-1.60714422e-19, 0.00000000e+00, -1.66533454e-16, ...,
        -1.37579722e-02, -1.22852355e-02, -1.69648792e-02],
       [ 7.02496386e-20, -1.24900090e-16, 4.85722573e-17, ...,
        -1.95381254e-02, -1.87159439e-02, 3.51135542e-02],
       [ 0.00000000e+00, -7.09946613e-02, 8.70675282e-02, ...,
         6.93889390e-17, 1.73472348e-18, -3.98986399e-17],
       [ 0.00000000e+00, -6.59517545e-03, 1.44650065e-02, ...,
         7.65446734e-17, 7.58941521e-18, -3.20923843e-17],
       [ 9.99996658e-01, -2.47687677e-03, 5.97910388e-04, ...,
         2.98155597e-19, 3.25260652e-19, -1.46909394e-17]])
# Cumuliative varinace of the PCs
variance cumu = np.cumsum(pca.explained variance ratio )
print(variance cumu)
[0.09825349 0.18709261 0.24088761 0.2883275 0.32798442 0.36609355
 0.39444897 0.42237794 0.44850192 0.47371472 0.49752572 0.52059546
 0.54229743 0.56350921 0.58315905 0.6016858 0.61813022 0.63293898
 0.64736378 0.66156044 0.67520537 0.68765645 0.69984057 0.71093521
 0.72160536 0.73180318 0.74173576 0.75139276 0.76048501 0.76889371
 0.7768848
           0.78462758 0.79205887 0.79918754 0.80590777 0.81247571
 0.81896067 0.82534164 0.83161288 0.83770289 0.84376501 0.84959825
 0.85517748 0.86061454 0.86584275 0.87089985 0.8757824
                                                        0.88025793
 0.88457894 0.88878312 0.89283235 0.89670077 0.9005251 0.90424925
```

```
0.90796057 0.91152051 0.91494825 0.91825106 0.92144558 0.92451668
 0.92747602 0.93038039 0.93322992 0.93604145 0.93880554 0.94154835
 0.94425275 0.94692886 0.94944619 0.95193451 0.95436333 0.95672582
                       0.96322525 0.96522079 0.96717096 0.96910572
 0.95904642 0.961167
 0.97096924 0.97282327 0.97464388 0.97641079 0.97813494 0.97981207
 0.9814719
            0.98307596 0.98466282 0.98615641 0.98753979 0.98880201
                       0.99222098 0.99325441 0.99416242 0.99502649
 0.99000818 0.9911786
 0.99585783 0.99657595 0.99725427 0.99786984 0.99846736 0.99895847
 0.99937265 0.99969781 0.99991637 0.99996401 0.99998599 0.99999758
 0.99999938 0.99999979 1.
                                   1.
                                               1.
                                                          1.
 1.
            1.
                                   1.
                                               1.
                                                          1.
                        1.
1.
            1.
                        1.
                                   1.
                                               1.
                                                          1.
 1.
                                   1.
                                               1.
            1.
                        1.
                                                          1.
 1.
            1.
# Plotting scree plot
fig = plt.figure(figsize = (10,6))
plt.plot(variance cumu)
plt.xlabel('Number of Components')
plt.ylabel('Cumulative Variance')
Text(0, 0.5, 'Cumulative Variance')
```



# Importing incremental PCA from sklearn.decomposition import Incremental PCA

```
# Instantiate PCA with 60 components
pca_final = IncrementalPCA(n_components=60)

# Fit and transform the X_train
X_train_pca = pca_final.fit_transform(X_train)

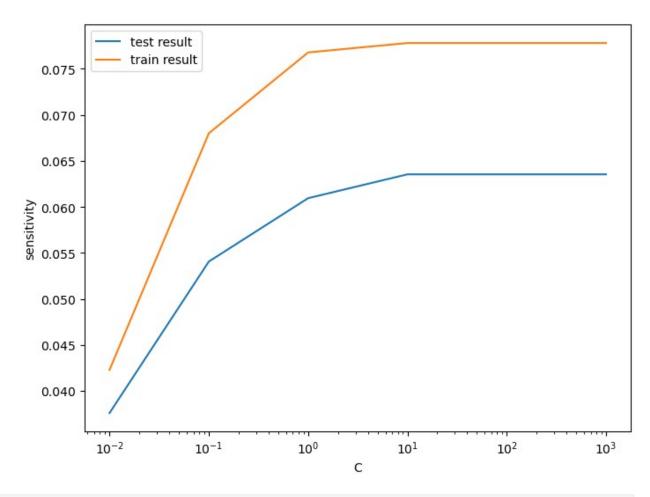
X_test_pca = pca_final.transform(X_test)
```

Logistic Regression Model:

```
# Importing scikit logistic regression module
from sklearn.linear model import LogisticRegression
# Impoting metrics
from sklearn import metrics
from sklearn.metrics import confusion matrix
# Importing libraries for cross validation
from sklearn.model selection import KFold
from sklearn.model selection import cross val score
from sklearn.model selection import GridSearchCV
# Creating KFold object with 5 splits
folds = KFold(n splits=5, shuffle=True, random state=4)
# Specify params
params = {"C": [0.01, 0.1, 1, 10, 100, 1000]}
# Specifing score as recall as we are more focused on acheiving the
higher sensitivity than the accuracy
model cv = GridSearchCV(estimator = LogisticRegression(),
                        param grid = params,
                        scoring= 'recall',
                        cv = folds,
                        verbose = 1,
                        return train score=True)
# Fit the model
model_cv.fit(X_train_pca, y_train)
Fitting 5 folds for each of 6 candidates, totalling 30 fits
GridSearchCV(cv=KFold(n splits=5, random state=4, shuffle=True),
             estimator=LogisticRegression(),
             param grid={'C': [0.01, 0.1, 1, 10, 100, 1000]},
             return train score=True, scoring='recall', verbose=1)
# results of grid search CV
cv results = pd.DataFrame(model cv.cv results )
cv results
```

```
mean_fit_time std_fit_time mean_score_time std score time
param C \
0
        0.066955
                       0.006613
                                          0.001706
                                                           0.000162
0.01
1
        0.176696
                       0.014135
                                          0.001862
                                                           0.000229
0.1
2
        0.212599
                       0.026409
                                          0.001672
                                                           0.000138
1
3
                                                           0.000016
        0.214728
                       0.028868
                                          0.001528
10
4
        0.199139
                       0.011242
                                          0.001647
                                                           0.000071
100
        0.221268
                       0.013491
                                          0.001606
                                                           0.000058
1000
                 split0 test score split1 test score
        params
split2 test score
0 \quad \{'C': 0.\overline{0}1\}
                           0.035971
                                               0.048780
0.055172
    {'C': 0.1}
                           0.064748
                                               0.060976
0.062069
      {'C': 1}
                           0.064748
                                               0.060976
0.068966
                           0.064748
                                               0.067073
3
     {'C': 10}
0.068966
    {'C': 100}
                           0.064748
                                               0.067073
0.068966
   {'C': 1000}
                           0.064748
                                               0.067073
0.068966
                       split4_test_score mean_test_score
   split3_test_score
std_test score \
0
             0.020690
                                 0.027397
                                                    0.037602
0.012857
             0.048276
                                 0.034247
                                                    0.054063
1
0.011421
             0.068966
                                 0.041096
                                                    0.060950
0.010364
                                                    0.063540
             0.068966
                                 0.047945
0.007950
             0.068966
                                 0.047945
                                                    0.063540
4
0.007950
             0.068966
                                 0.047945
                                                    0.063540
0.007950
   rank test score
                     split0 train score
                                           split1 train score \
0
                  6
                                0.043333
                                                      0.043478
1
                  5
                                0.070000
                                                      0.069565
2
                  4
                                0.083333
                                                      0.078261
3
                                0.083333
                                                      0.080000
```

```
4
                  1
                               0.083333
                                                    0.080000
5
                  1
                               0.083333
                                                    0.080000
                        split3_train_score
   split2 train score
                                             split4 train score \
0
             0.043771
                                  0.042088
                                                        0.038786
1
             0.079125
                                  0.060606
                                                        0.060708
2
             0.085859
                                  0.067340
                                                        0.069140
3
             0.087542
                                  0.067340
                                                        0.070826
4
             0.087542
                                  0.067340
                                                        0.070826
5
             0.087542
                                  0.067340
                                                        0.070826
                      std train score
   mean_train_score
                             0.\overline{0}01845
0
           0.042291
1
                             0.006900
           0.068001
2
           0.076787
                             0.007417
3
                             0.007595
           0.077808
4
           0.077808
                             0.007595
5
           0.077808
                             0.007595
# plot of C versus train and validation scores
plt.figure(figsize=(8, 6))
plt.plot(cv_results['param_C'], cv_results['mean_test_score'])
plt.plot(cv results['param C'], cv results['mean train score'])
plt.xlabel('C')
plt.ylabel('sensitivity')
plt.legend(['test result', 'train result'], loc='upper left')
plt.xscale('log')
```



```
# Best score with best C
best_score = model_cv.best_score_
best_C = model_cv.best_params_['C']

print(" The highest test sensitivity is {0} at C = {1}".format(best_score, best_C))

The highest test sensitivity is 0.06353952242655339 at C = 10

# Instantiate the model with best C
logistic_pca = LogisticRegression(C=best_C)

# Fit the model on the train set
log_pca_model = logistic_pca.fit(X_train_pca, y_train)

# Predictions on the train set
y_train_pred = log_pca_model.predict(X_train_pca)

# Confusion matrix
confusion = metrics.confusion_matrix(y_train, y_train_pred)
print(confusion)
```

```
[[21374
           511
686
          5311
TP = confusion[1,1] # true positive
TN = confusion[0,0] # true negatives
FP = confusion[0,1] # false positives
FN = confusion[1,0] # false negatives
# Accuracy
print("Accuracy:-",metrics.accuracy score(y train, y train pred))
# Sensitivity
print("Sensitivity:-",TP / float(TP+FN))
# Specificity
print("Specificity:-", TN / float(TN+FP))
Accuracy: - 0.9667478794441436
Sensitivity: - 0.07171853856562922
Specificity: - 0.9976196032672112
# Prediction on the test set
y test pred = log pca model.predict(X test pca)
# Confusion matrix
confusion = metrics.confusion matrix(y test, y test pred)
print(confusion)
[[5335
        131
        1711
「 176
TP = confusion[1,1] # true positive
TN = confusion[0,0] # true negatives
FP = confusion[0,1] # false positives
FN = confusion[1,0] # false negatives
# Accuracy
print("Accuracy:-",metrics.accuracy score(y test, y test pred))
# Sensitivity
print("Sensitivity:-",TP / float(TP+FN))
# Specificity
print("Specificity:-", TN / float(TN+FP))
Accuracy: - 0.9658906334596643
Sensitivity: - 0.08808290155440414
Specificity: - 0.9975691847419597
```