In [4]:
```
### basic package for data science project
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import numpy as np

import warnings
warnings.filterwarnings("ignore")
%matplotlib inline
sns.set()
```

In [6]:
```
!jupyter nbconvert --to webpdf --allow-chromium-download EDA.ipynb
```

Thoughts:

- Since data dictionary is not provided, it is hard to tell the meaning of numerical features
- I think it is best to first seperate the categorical fts and numerical fts and hanle them separately.

For numerical features:

- Exclude columns with more than 75% of the values missing
- Impute missing values with mean/median/mode

For categorical features:

- Focus on understand the features
- Creat dummy variable to represent the feature in an appropriate format for training data
- remove x39 since all variables have the same value
- remove x99 since 32% are missing values and the rest has the same value

Helper function

In [7]:
```
def create_dummy_df(df, cat_cols, dummy_na):
    '''
    INPUT:
    df - pandas dataframe with categorical variables you want to dummy
    cat_cols - list of strings that are associated with names of the categorical columns
    dummy_na - Bool holding whether you want to dummy NA vals of categorical columns or no

    OUTPUT:
    df - a new dataframe that has the following characteristics:
            1. contains all columns that were not specified as categorical
            2. removes all the original columns in cat_cols
            3. dummy columns for each of the categorical columns in cat_cols
            4. if dummy_na is True - it also contains dummy co lumns for the NaN values
            5. Use a prefix of the column name with an underscore (_) for separating
    '''
    for col in  cat_cols:
        try:
            # for each cat add dummy var, drop original column
            df = pd.concat([df.drop(col, axis=1),\
                            pd.get_dummies(df[col], prefix=col, prefix_sep='_', drop_first
        except:
```

```
            continue
    return df

def clean_day_x3_col(date):
    if date.lower() == 'tue':
        return 'Tuesday'
    elif date.lower() == 'mon':
        return 'Monday'
    elif date.lower() == 'wed':
        return 'Wednesday'
    elif date.lower() == 'thur':
        return 'Thursday'
    elif date.lower() == 'fri':
        return 'Friday'
    elif date.lower() == 'sat':
        return 'Saturday'
    elif date.lower() == 'sun':
        return 'Sunday'
    else:
        return date
```

Data summary

In [8]:
```
df = pd.read_csv("data/exercise_40_train.csv")
df.describe()
```

Out[8]:

	y	x1	x2	x4	x5	x6	x8	
count	40000.000000	40000.000000	40000.000000	40000.000000	37572.000000	40000.000000	40000.000000	40000.0000
mean	0.145075	2.999958	20.004865	0.002950	0.005396	0.007234	0.004371	2.7223
std	0.352181	1.994490	1.604291	1.462185	1.297952	1.358551	1.447223	1.9668
min	0.000000	-3.648431	13.714945	-5.137161	-5.616412	-6.113153	-6.376810	-3.1434
25%	0.000000	1.592714	18.921388	-1.026798	-0.872354	-0.909831	-0.971167	1.3404
50%	0.000000	2.875892	20.005944	0.002263	0.008822	0.007335	0.002226	2.4988
75%	0.000000	4.270295	21.083465	1.043354	0.892467	0.926222	0.985023	3.8277
max	1.000000	13.837591	27.086468	5.150153	5.698128	5.639372	5.869889	18.0066

8 rows × 89 columns

In [9]:
```
df.drop_duplicates().shape ## no duplicates
```

Out[9]:
```
(40000, 101)
```

In [11]:
```
display(df.info())
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 40000 entries, 0 to 39999
Columns: 101 entries, y to x100
dtypes: float64(86), int64(3), object(12)
memory usage: 30.8+ MB
None
```

In [12]:
```
df.head()
```

Out[12]:

	y	x1	x2	x3	x4	x5	x6	x7	x8	x9	...	x91	
0	0	0.165254	18.060003	Wed	1.077380	-1.339233	-1.584341	0.0062%	0.220784	1.816481	...	-0.397427	0.9
1	1	2.441471	18.416307	Friday	1.482586	0.920817	-0.759931	0.0064%	1.192441	3.513950	...	0.656651	9.0
2	1	4.427278	19.188092	Thursday	0.145652	0.366093	0.709962	-8e-04%	0.952323	0.782974	...	2.059615	0.3
3	0	3.925235	19.901257	Tuesday	1.763602	-0.251926	-0.827461	-0.0057%	-0.520756	1.825586	...	0.899392	5.9
4	0	2.868802	22.202473	Sunday	3.405119	0.083162	1.381504	0.0109%	-0.732739	2.151990	...	3.003595	1.0

5 rows × 101 columns

In [ ]:

```
```

Missing value

In [13]:

```
no_nulls = set(df.columns[df.isnull().mean()==0])
len(no_nulls)
```

Out[13]:

```
59
```

In [14]:

```
null_cols = set(df.columns[df.isnull().mean()!=0])
len(null_cols)
```

Out[14]:

```
42
```

In [15]:

```
most_missing_cols = set(df.columns[df.isnull().mean() > 0.4])
len(most_missing_cols)
```

Out[15]:

```
5
```

In [16]:

```
df.columns[df.isnull().mean() > 0.4]
```

Out[16]:

```
Index(['x30', 'x44', 'x52', 'x55', 'x57'], dtype='object')
```

Numerical features

In [17]:

```
non_null_df = df.loc[:, (~df.columns.isin(most_missing_cols))]
non_null_df.head()
```

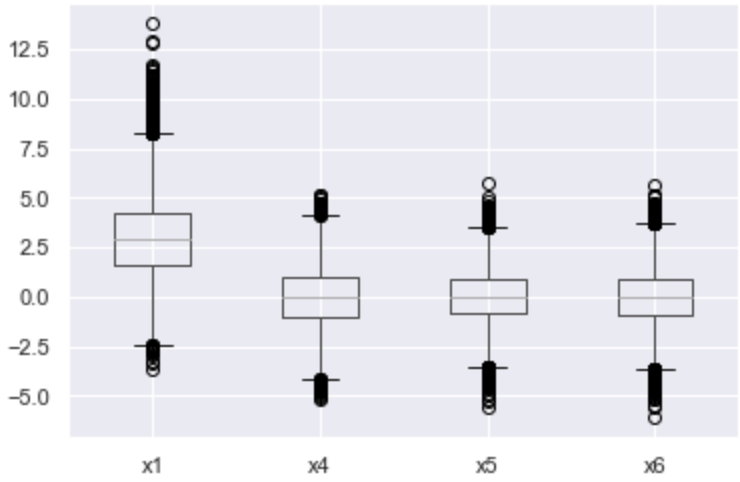
Out[17]:

	y	x1	x2	x3	x4	x5	x6	x7	x8	x9	...	x91	
0	0	0.165254	18.060003	Wed	1.077380	-1.339233	-1.584341	0.0062%	0.220784	1.816481	...	-0.397427	0.9
1	1	2.441471	18.416307	Friday	1.482586	0.920817	-0.759931	0.0064%	1.192441	3.513950	...	0.656651	9.0
2	1	4.427278	19.188092	Thursday	0.145652	0.366093	0.709962	-8e-04%	0.952323	0.782974	...	2.059615	0.3
3	0	3.925235	19.901257	Tuesday	1.763602	-0.251926	-0.827461	-0.0057%	-0.520756	1.825586	...	0.899392	5.9
4	0	2.868802	22.202473	Sunday	3.405119	0.083162	1.381504	0.0109%	-0.732739	2.151990	...	3.003595	1.0

5 rows × 96 columns

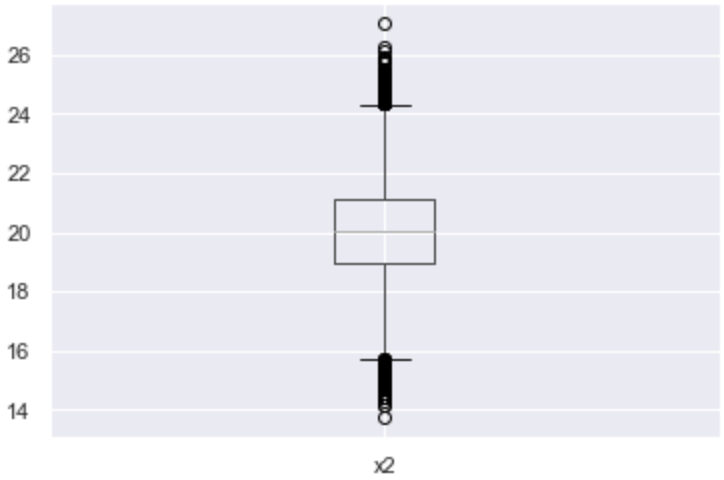
In [21]:
```
non_null_df.boxplot(column=['x1', 'x4', 'x5', 'x6'])
```

Out[21]:
```
<AxesSubplot:>
```



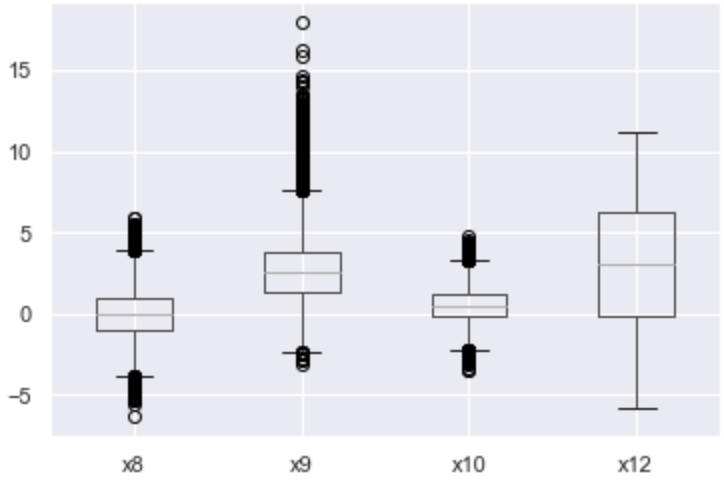
In [23]:
```
non_null_df.boxplot(column=['x2'])
```

Out[23]:
```
<AxesSubplot:>
```



In [20]:
```
non_null_df.boxplot(column=['x8', 'x9', 'x10', 'x12'])
```

Out[20]:
```
<AxesSubplot:>
```



Categorial features EDA

In [12]:
```
#### find catergorical features
cat_cols = df.select_dtypes(include=['object']).columns
cat_df = df.select_dtypes(include=['object'])
cat_df['y'] = df['y']

#### clean col x7 and x19
cat_df['x7'] = cat_df['x7'].str.replace('%','')
cat_df["x19"] = cat_df['x19'].str.replace('$','')
cat_df = cat_df.astype({'x7': 'float', 'x19': 'float'})

#### clean x3 col
cat_df['x3'] = cat_df.apply(lambda x: clean_day_x3_col(x['x3']), axis = 1)

cat_df.head()
```

Out[12]:

	x3	x7	x19	x24	x31	x33	x39	x60	x65	x77	x93	x99	y
0	Wednesday	0.0062	-908.650758	female	no	Colorado	5-10 miles	August	farmers	mercedes	no	yes	0
1	Friday	0.0064	-1864.962288	male	no	Tennessee	5-10 miles	April	allstate	mercedes	no	yes	1
2	Thursday	-0.0008	-543.187403	male	no	Texas	5-10 miles	September	geico	subaru	no	yes	1
3	Tuesday	-0.0057	-182.626381	male	no	Minnesota	5-10 miles	September	geico	nissan	no	yes	0
4	Sunday	0.0109	967.007091	male	yes	New York	5-10 miles	January	geico	toyota	yes	yes	0

In [13]:
```
len(cat_cols)
```

Out[13]:
```
12
```

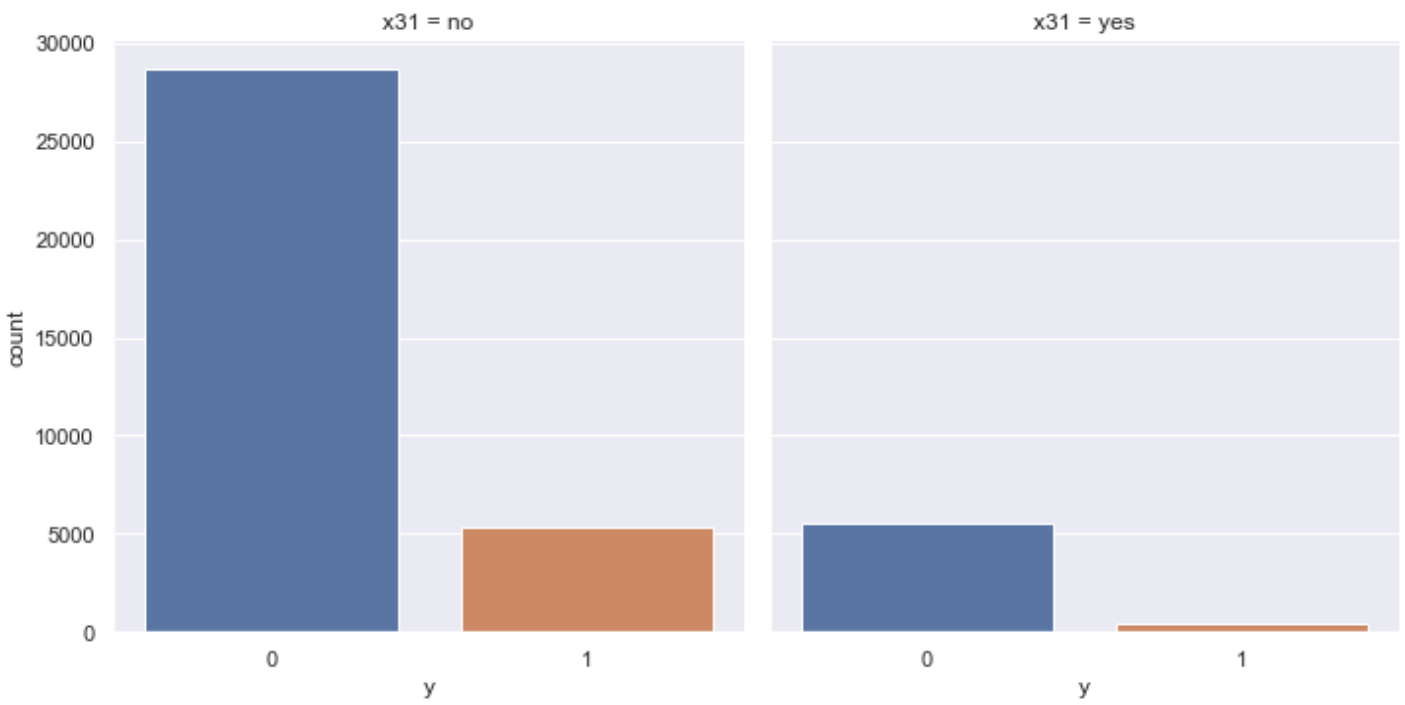
In [14]:
```
### cat columns with missing values
set(cat_df.columns[cat_df.isnull().mean() != 0])
```

Out[14]:
```
{'x24', 'x33', 'x77', 'x99'}
```

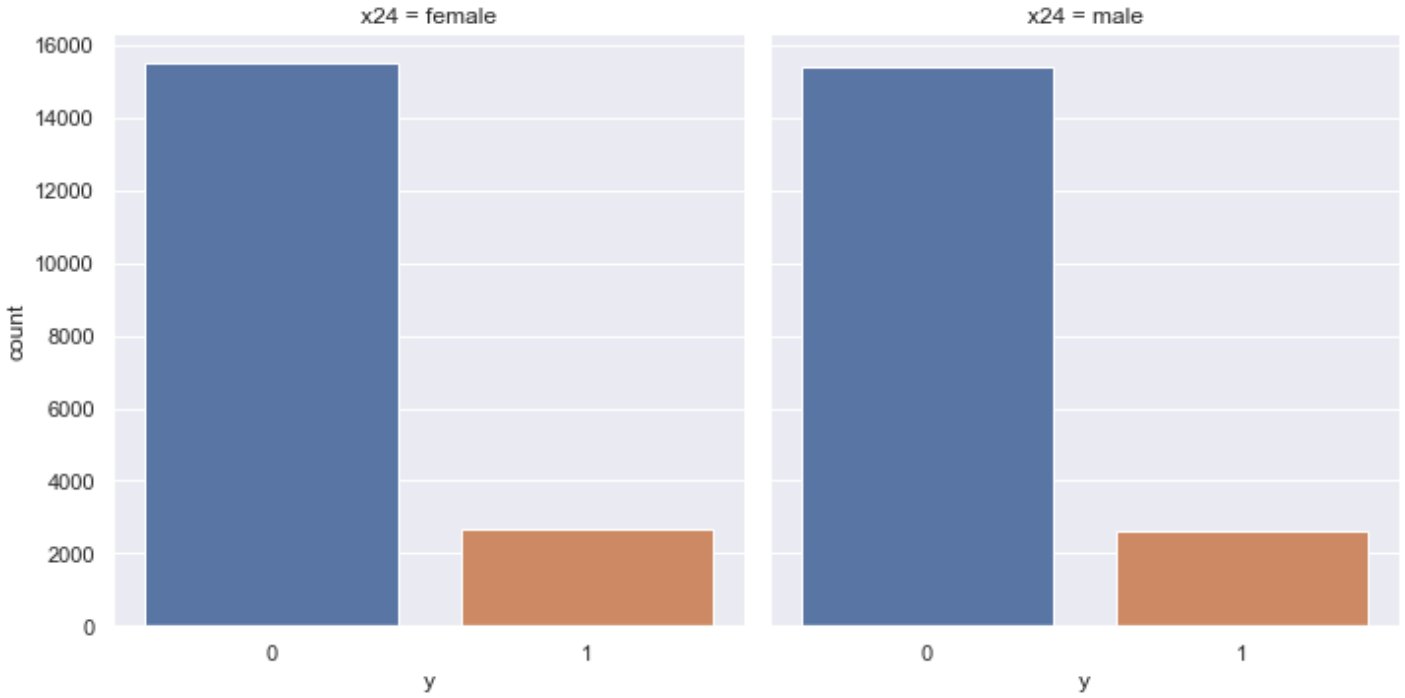
In [15]:
```
cat_df.isnull().mean()
```

Out[15]:
```
x3     0.000000
x7     0.000000
x19    0.000000
x24    0.096400
x31    0.000000
x33    0.179275
x39    0.000000
x60    0.000000
x65    0.000000
x77    0.231425
x93    0.000000
x99    0.320900
y      0.000000
dtype: float64
```

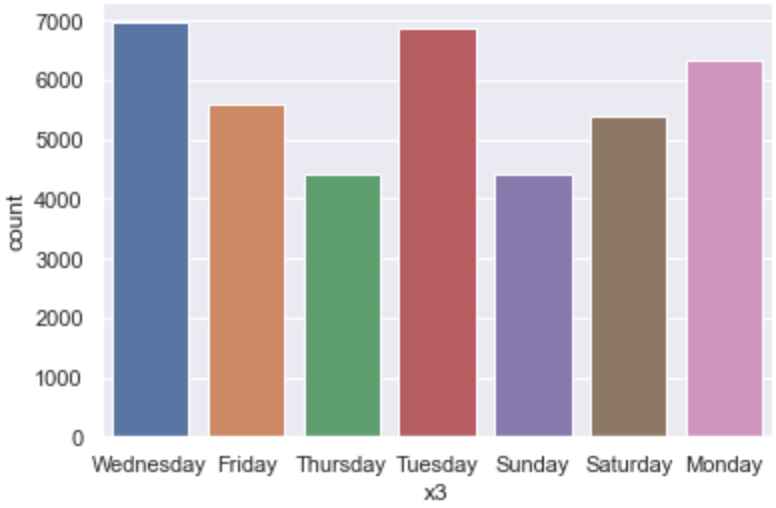
In [16]:
```
sns.factorplot(x='y', col='x31', kind='count', data=cat_df);
```



In [17]:
```
sns.factorplot(x='y', col='x24', kind='count', data=cat_df);
```



In [18]:
```
sns.countplot(x='x3', data=cat_df);
```



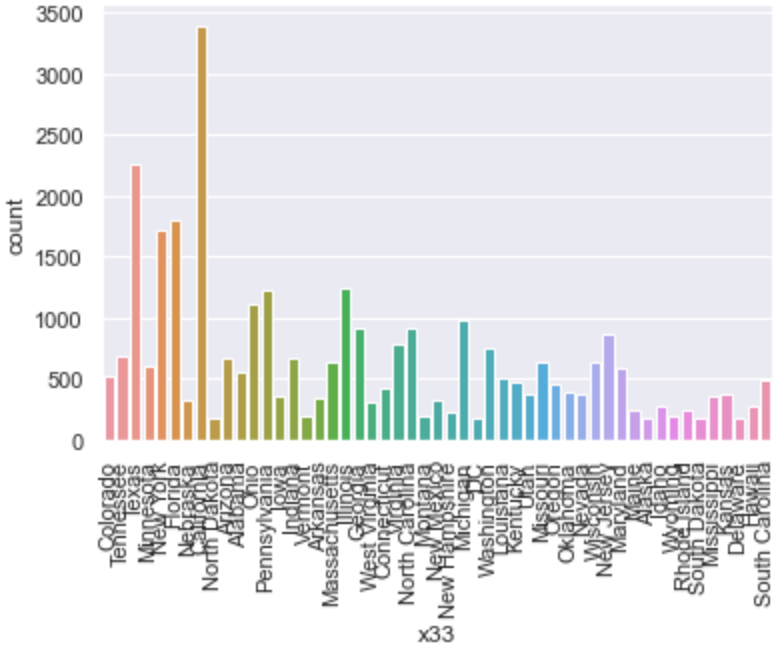
In [137…

```
chart = sns.countplot(x='x33', data=cat_df);
chart.set_xticklabels(chart.get_xticklabels(), rotation=90)
```

Out[137…

```
[Text(0, 0, 'Colorado'),
 Text(1, 0, 'Tennessee'),
 Text(2, 0, 'Texas'),
 Text(3, 0, 'Minnesota'),
 Text(4, 0, 'New York'),
 Text(5, 0, 'Florida'),
 Text(6, 0, 'Nebraska'),
 Text(7, 0, 'California'),
 Text(8, 0, 'North Dakota'),
 Text(9, 0, 'Arizona'),
 Text(10, 0, 'Alabama'),
 Text(11, 0, 'Ohio'),
 Text(12, 0, 'Pennsylvania'),
 Text(13, 0, 'Iowa'),
 Text(14, 0, 'Indiana'),
 Text(15, 0, 'Vermont'),
 Text(16, 0, 'Arkansas'),
 Text(17, 0, 'Massachusetts'),
 Text(18, 0, 'Illinois'),
 Text(19, 0, 'Georgia'),
 Text(20, 0, 'West Virginia'),
 Text(21, 0, 'Connecticut'),
 Text(22, 0, 'Virginia'),
 Text(23, 0, 'North Carolina'),
 Text(24, 0, 'Montana'),
 Text(25, 0, 'New Mexico'),
 Text(26, 0, 'New Hampshire'),
 Text(27, 0, 'Michigan'),
 Text(28, 0, 'DC'),
 Text(29, 0, 'Washington'),
 Text(30, 0, 'Louisiana'),
 Text(31, 0, 'Kentucky'),
 Text(32, 0, 'Utah'),
 Text(33, 0, 'Missouri'),
 Text(34, 0, 'Oregon'),
 Text(35, 0, 'Oklahoma'),
 Text(36, 0, 'Nevada'),
 Text(37, 0, 'Wisconsin'),
 Text(38, 0, 'New Jersey'),
 Text(39, 0, 'Maryland'),
 Text(40, 0, 'Maine'),
 Text(41, 0, 'Alaska'),
 Text(42, 0, 'Idaho'),
 Text(43, 0, 'Wyoming'),
```

```
 Text(44, 0, 'Rhode Island'),
 Text(45, 0, 'South Dakota'),
 Text(46, 0, 'Mississippi'),
 Text(47, 0, 'Kansas'),
 Text(48, 0, 'Delaware'),
 Text(49, 0, 'Hawaii'),
 Text(50, 0, 'South Carolina')]
```

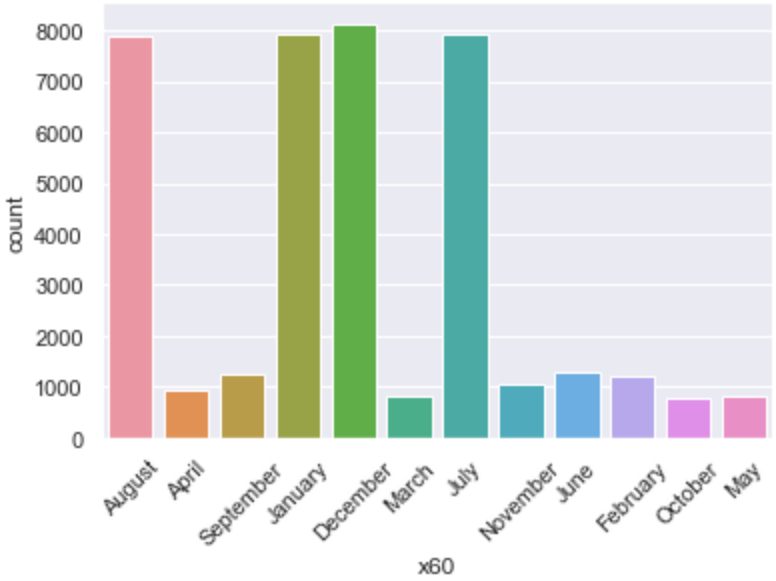


In [126…

```
chart = sns.countplot(x='x60', data=cat_df);
chart.set_xticklabels(chart.get_xticklabels(), rotation=45)
```

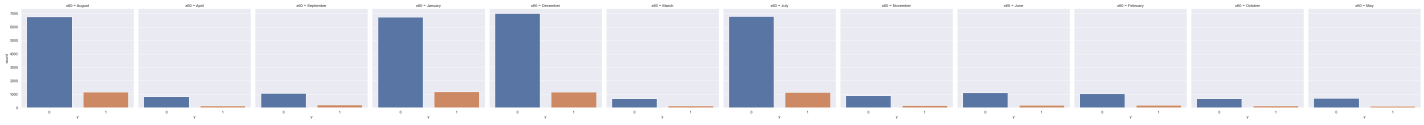
Out[126…

```
[Text(0, 0, 'August'),
 Text(1, 0, 'April'),
 Text(2, 0, 'September'),
 Text(3, 0, 'January'),
 Text(4, 0, 'December'),
 Text(5, 0, 'March'),
 Text(6, 0, 'July'),
 Text(7, 0, 'November'),
 Text(8, 0, 'June'),
 Text(9, 0, 'February'),
 Text(10, 0, 'October'),
 Text(11, 0, 'May')]
```



In [127…

```
sns.factorplot(x='y', col='x60', kind='count', data=cat_df);
```

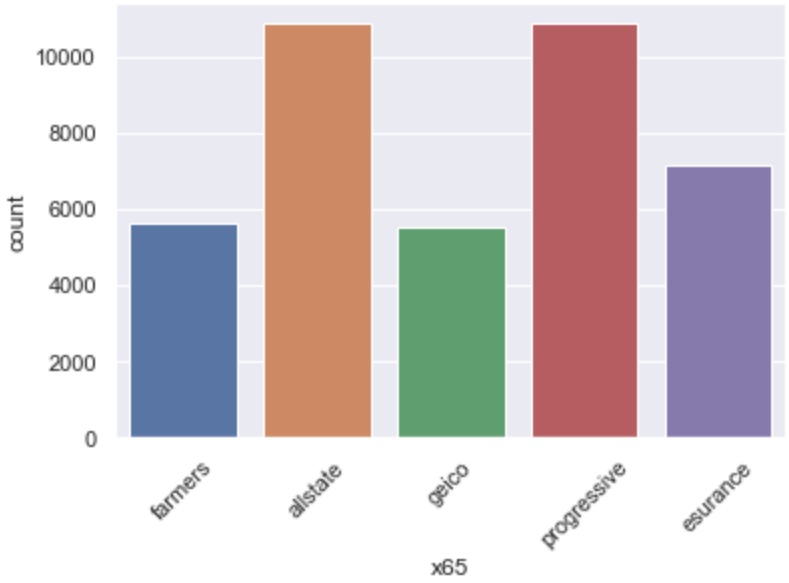


In [129…

```
chart = sns.countplot(x='x65', data=cat_df);
chart.set_xticklabels(chart.get_xticklabels(), rotation=45)
```

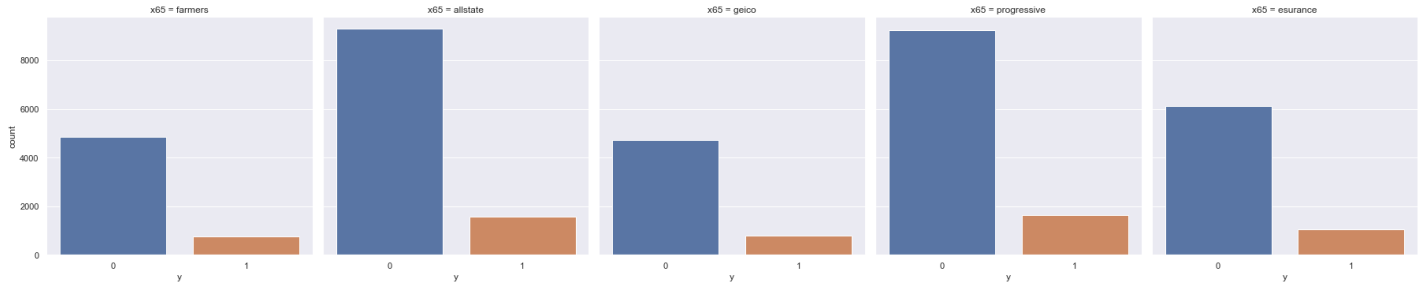
Out[129…

```
[Text(0, 0, 'farmers'),
 Text(1, 0, 'allstate'),
 Text(2, 0, 'geico'),
 Text(3, 0, 'progressive'),
 Text(4, 0, 'esurance')]
```



In [128…

```
sns.factorplot(x='y', col='x65', kind='count', data=cat_df);
```

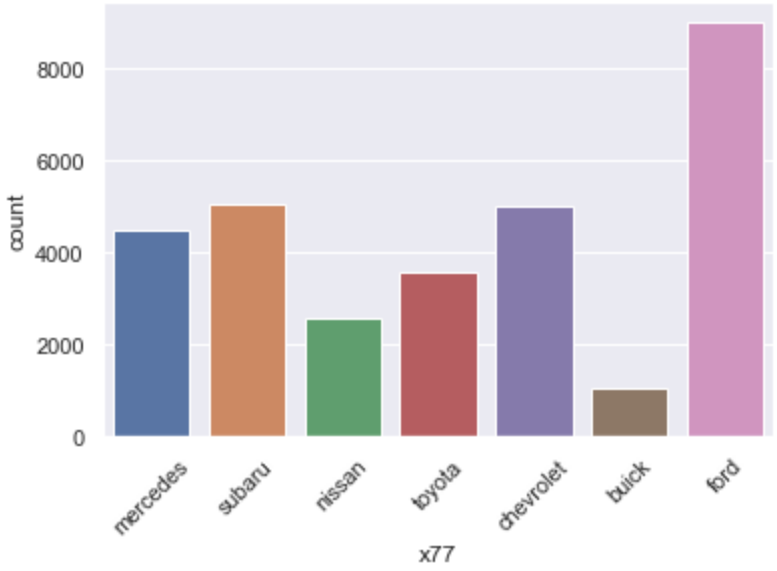


In [130…

```
chart = sns.countplot(x='x77', data=cat_df);
chart.set_xticklabels(chart.get_xticklabels(), rotation=45)
```

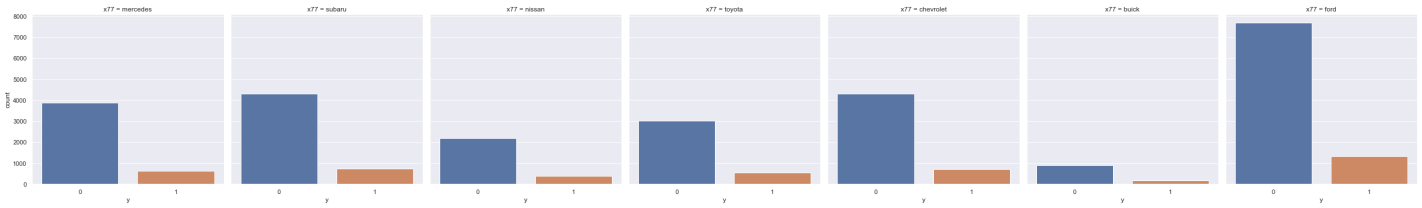
Out[130…

```
[Text(0, 0, 'mercedes'),
 Text(1, 0, 'subaru'),
 Text(2, 0, 'nissan'),
 Text(3, 0, 'toyota'),
 Text(4, 0, 'chevrolet'),
 Text(5, 0, 'buick'),
 Text(6, 0, 'ford')]
```



In [131…

```
sns.factorplot(x='y', col='x77', kind='count', data=cat_df);
```

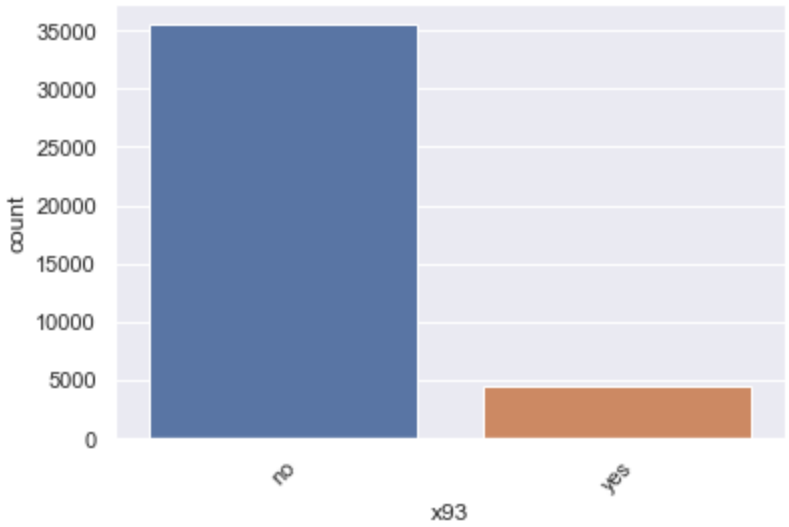


In [132…

```
chart = sns.countplot(x='x93', data=cat_df);
chart.set_xticklabels(chart.get_xticklabels(), rotation=45)
```

Out[132…

```
[Text(0, 0, 'no'), Text(1, 0, 'yes')]
```

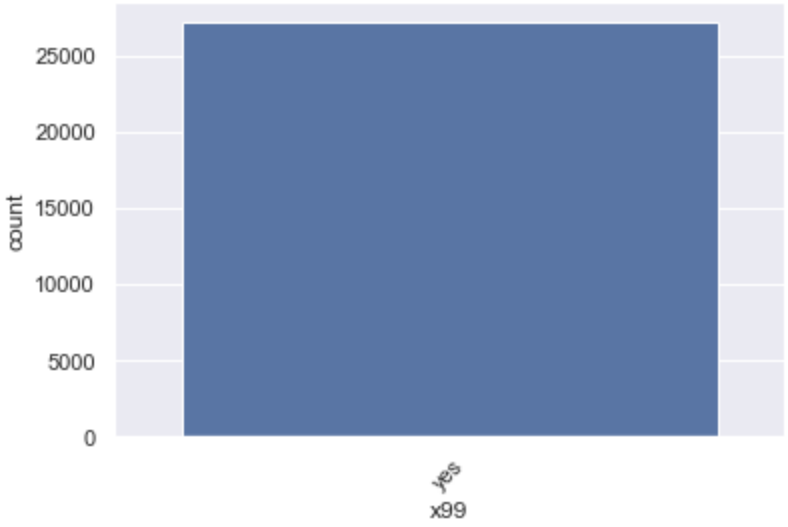


In [133…

```
chart = sns.countplot(x='x99', data=cat_df);
chart.set_xticklabels(chart.get_xticklabels(), rotation=45)
```

Out[133…

```
[Text(0, 0, 'yes')]
```



In [123…
```
cat_df['x39'].value_counts()
```

Out[123…
```
5-10 miles    40000
Name: x39, dtype: int64
```

In [124…
```
cat_df['x60'].value_counts()
```

Out[124…
```
December     8136
January      7922
July         7912
August       7907
June         1272
September    1245
February     1213
November     1043
April         951
March         807
May           799
October       793
Name: x60, dtype: int64
```

In [175…
```
clean_df = create_dummy_df(df, cat_cols, dummy_na=True)
clean_df
```

Out[175…

	y	x1	x2	x4	x5	x6	x8	x9	x10	x11	…	x77
0	0	0.165254	18.060003	1.077380	-1.339233	-1.584341	0.220784	1.816481	1.171788	109.626841	…	
1	1	2.441471	18.416307	1.482586	0.920817	-0.759931	1.192441	3.513950	1.419900	84.079367	…	
2	1	4.427278	19.188092	0.145652	0.366093	0.709962	0.952323	0.782974	-1.247022	95.375221	…	
3	0	3.925235	19.901257	1.763602	-0.251926	-0.827461	-0.520756	1.825586	2.223038	96.420382	…	
4	0	2.868802	22.202473	3.405119	0.083162	1.381504	-0.732739	2.151990	-0.275406	90.769952	…	
…	…	…	…	…	…	…	…	…	…	…	…	…
39995	0	1.593480	19.628352	0.794697	-0.825849	0.608774	2.183834	3.202119	-0.723356	94.820410	…	
39996	0	1.708685	17.132638	-2.676659	1.153851	0.465905	-0.048613	3.989567	1.468074	115.785563	…	
39997	0	1.704132	17.824399	-0.581360	NaN	0.467339	0.904643	2.975563	0.228908	107.939412	…	
39998	0	3.963408	20.285597	0.430116	0.050189	1.821565	-0.401259	-0.247649	-0.499294	93.314126	…	
39999	0	2.574164	16.442850	-1.166067	-1.198482	0.180549	-0.273818	10.333122	1.648048	107.167219	…	

40000 rows × 40788 columns

In [ ]: