Customer Retention

E-retail factors for customer activation and retention: A case study from Indian e-commerce customers

- Customer satisfaction has emerged as one of the most important factors that guarantee the success of online store; it has been posited as a key stimulant of purchase, repurchase intentions and customer loyalty.
- A comprehensive review of the literature, theories and models have been carried out to propose the models for customer activation and customer retention.
- Five major factors that contributed to the success of an e-commerce store have been identified as: service quality, system quality, information quality, trust and net benefit.
- The research furthermore investigated the factors that influence the online customers repeat purchase intention.
- The combination of both utilitarian value and hedonistic values are needed to affect the repeat purchase intention (loyalty) positively. The data is collected from the Indian online shoppers.
- Results indicate the e-retail success factors, which are very much critical for customer satisfaction.
- The number of column(s) is more than 47. Read the column header carefully.

Note : Data Scientists have to apply their analytical skills to give findings and conclusions in detailed data analysis written in jupyter notebook . Only data analysis is required.

Importing Neccessary Libraries

In [1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns

from sklearn.linear_model import LogisticRegression
from sklearn.svm import SVC
from sklearn.tree import DecisionTreeClassifier
from sklearn.ensemble import RandomForestClassifier
from sklearn.neighbors import KNeighborsClassifier

from sklearn.preprocessing import LabelEncoder, StandardScaler
from sklearn.metrics import accuracy_score,confusion_matrix,classification_report
from sklearn.model_selection import train_test_split,GridSearchCV,KFold,cross_val
from statsmodels.stats.outliers_influence import variance_inflation_factor
from sklearn.utils import resample
from scipy.stats import zscore
import warnings
warnings.filterwarnings('ignore')
```

In [2]:
```
# Loading Dataset
df = pd.read_excel('customer_retention_dataset.xlsx')
df.head()
```

Out[2]:

	1Gender of respondent	2 How old are you?	3 Which city do you shop online from?	4 What is the Pin Code of where you shop online from?	5 Since How Long You are Shopping Online ?	6 How many times you have made an online purchase in the past 1 year?	7 How do you access the internet while shopping on-line?	8 Which device do you use to access the online shopping?	9 What is the screen size of your mobile device? \t\t\t\t\t\t	1 sy
0	Male	31-40 years	Delhi	110009	Above 4 years	31-40 times	Dial-up	Desktop	Others	Win
1	Female	21-30 years	Delhi	110030	Above 4 years	41 times and above	Wi-Fi	Smartphone	4.7 inches	
2	Female	21-30 years	Greater Noida	201308	3-4 years	41 times and above	Mobile Internet	Smartphone	5.5 inches	
3	Male	21-30 years	Karnal	132001	3-4 years	Less than 10 times	Mobile Internet	Smartphone	5.5 inches	
4	Female	21-30 years	Bangalore	530068	2-3 years	11-20 times	Wi-Fi	Smartphone	4.7 inches	

5 rows × 71 columns

Exploratory Data Analysis(EDA)

Firstly to understand about the dataset, we should know how much data is there in the dataset.

In [3]:
```
# Checking the dimensions of this dataset.
df.shape
```

Out[3]:
```
(269, 71)
```

- Data set contains 269 rows and 71 columns.

In [4]:
```
# checkng the columns present in the dataset.
df.columns
```

Out[4]:
```
Index(['1Gender of respondent', '2 How old are you? ',
       '3 Which city do you shop online from?',
       '4 What is the Pin Code of where you shop online from?',
       '5 Since How Long You are Shopping Online ?',
       '6 How many times you have made an online purchase in the past 1 year?',
       '7 How do you access the internet while shopping on-line?',
       '8 Which device do you use to access the online shopping?',
       '9 What is the screen size of your mobile device?\t\t\t\t\t\t
',
       '10 What is the operating system (OS) of your device?\t\t\t\t
',
       '11 What browser do you run on your device to access the website?\t\t\t
',
       '12 Which channel did you follow to arrive at your favorite online store
for the first time?
',
       '13 After first visit, how do you reach the online retail store?\t\t\t\t
',
       '14 How much time do you explore the e- retail store before making a pur
chase decision?
',
       '15 What is your preferred payment Option?\t\t\t\t\t
',
       '16 How frequently do you abandon (selecting an items and leaving withou
t making payment) your shopping cart?\t\t\t\t\t\t\t
',
       '17 Why did you abandon the “Bag”, “Shopping Cart”?\t\t\t\t\t
',
       '18 The content on the website must be easy to read and understand',
       '19 Information on similar product to the one highlighted  is important
for product comparison',
       '20 Complete information on listed seller and product being offered is i
mportant for purchase decision.',
       '21 All relevant information on listed products must be stated clearly',
       '22 Ease of navigation in website', '23 Loading and processing speed',
       '24 User friendly Interface of the website',
       '25 Convenient Payment methods',
       '26 Trust that the online retail store will fulfill its part of the tran
saction at the stipulated time',
       '27 Empathy (readiness to assist with queries) towards the customers',
       '28 Being able to guarantee the privacy of the customer',
       '29 Responsiveness, availability of several communication channels (emai
l, online rep, twitter, phone etc.)',
       '30 Online shopping gives monetary benefit and discounts',
       '31 Enjoyment is derived from shopping online',
       '32 Shopping online is convenient and flexible',
       '33 Return and replacement policy of the e-tailer is important for purch
ase decision',
       '34 Gaining access to loyalty programs is a benefit of shopping online',
       '35 Displaying quality Information on the website improves satisfaction
of customers',
       '36 User derive satisfaction while shopping on a good quality website or
application',
       '37 Net Benefit derived from shopping online can lead to users satisfact
```

```
ion',
       '38 User satisfaction cannot exist without trust',
       '39 Offering a wide variety of listed product in several category',
       '40 Provision of complete and relevant product information',
       '41 Monetary savings',
       '42 The Convenience of patronizing the online retailer',
       '43 Shopping on the website gives you the sense of adventure',
       '44 Shopping on your preferred e-tailer enhances your social status',
       '45 You feel gratification shopping on your favorite e-tailer',
       '46 Shopping on the website helps you fulfill certain roles',
       '47 Getting value for money spent',
       'From the following, tick any (or all) of the online retailers you have
shopped from;
',
       'Easy to use website or application',
       'Visual appealing web-page layout', 'Wild variety of product on offer',
       'Complete, relevant description information of products',
       'Fast loading website speed of website and application',
       'Reliability of the website or application',
       'Quickness to complete purchase',
       'Availability of several payment options', 'Speedy order delivery ',
       'Privacy of customers' information',
       'Security of customer financial information',
       'Perceived Trustworthiness',
       'Presence of online assistance through multi-channel',
       'Longer time to get logged in (promotion, sales period)',
       'Longer time in displaying graphics and photos (promotion, sales perio
d)',
       'Late declaration of price (promotion, sales period)',
       'Longer page loading time (promotion, sales period)',
       'Limited mode of payment on most products (promotion, sales period)',
       'Longer delivery period', 'Change in website/Application design',
       'Frequent disruption when moving from one page to another',
       'Website is as efficient as before',
       'Which of the Indian online retailer would you recommend to a friend?'],
      dtype='object')
```

- There is space and characters present in the dataset.

In [5]:
```
# Remove tabs,space and digits present in column names.
from string import digits
df.columns = df.columns.str.replace('\t','')
remove_digits = str.maketrans('', '', digits)
df.columns = df.columns.str.translate(remove_digits)
df.columns = df.columns.str.strip()
```

In [6]:
```
# Cheching the datatypes of all the columns.
df.dtypes
```

Out[6]:
```
Gender of respondent                                                 object
How old are you?                                                     object
Which city do you shop online from?                                  object
What is the Pin Code of where you shop online from?                   int64
Since How Long You are Shopping Online ?                             object
                                                                      ...
Longer delivery period                                               object
Change in website/Application design                                 object
Frequent disruption when moving from one page to another             object
Website is as efficient as before                                    object
Which of the Indian online retailer would you recommend to a friend?    object
Length: 71, dtype: object
```

- Seems that most of the columns are object variables present in the dataset.
- only 1 int i.e, for column "What is the Pin Code of where you shop online from? "

In [7]:
```
# For getting the overview of the dataset
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 269 entries, 0 to 268
Data columns (total 71 columns):
 #   Column
Non-Null Count  Dtype
---  ------
--------------  -----
 0   Gender of respondent
269 non-null    object
 1   How old are you?
269 non-null    object
 2   Which city do you shop online from?
269 non-null    object
 3   What is the Pin Code of where you shop online from?
269 non-null    int64
 4   Since How Long You are Shopping Online ?
269 non-null    object
 5   How many times you have made an online purchase in the past  year?
269 non-null    object
```

- There are 1 int and 70 object variables present in the dataset.

In [8]:
```
# checking the null values in the dataframe
df.isnull().sum()
```

Out[8]:
```
Gender of respondent                                                0
How old are you?                                                    0
Which city do you shop online from?                                 0
What is the Pin Code of where you shop online from?                 0
Since How Long You are Shopping Online ?                            0
                                                                   ..
Longer delivery period                                              0
Change in website/Application design                                0
Frequent disruption when moving from one page to another            0
Website is as efficient as before                                   0
Which of the Indian online retailer would you recommend to a friend?    0
Length: 71, dtype: int64
```

- Seems there is no missing value present in the dataset.

In [9]:
```
df.nunique()
```

Out[9]:
```
Gender of respondent                                                2
How old are you?                                                    5
Which city do you shop online from?                                11
What is the Pin Code of where you shop online from?                39
Since How Long You are Shopping Online ?                            5
                                                                   ..
Longer delivery period                                              6
Change in website/Application design                                7
Frequent disruption when moving from one page to another            8
Website is as efficient as before                                   8
Which of the Indian online retailer would you recommend to a friend?    8
Length: 71, dtype: int64
```

- All the Variables or Features are Categorical type.

In [10]:
```
# Summary statistics
df.describe()
```

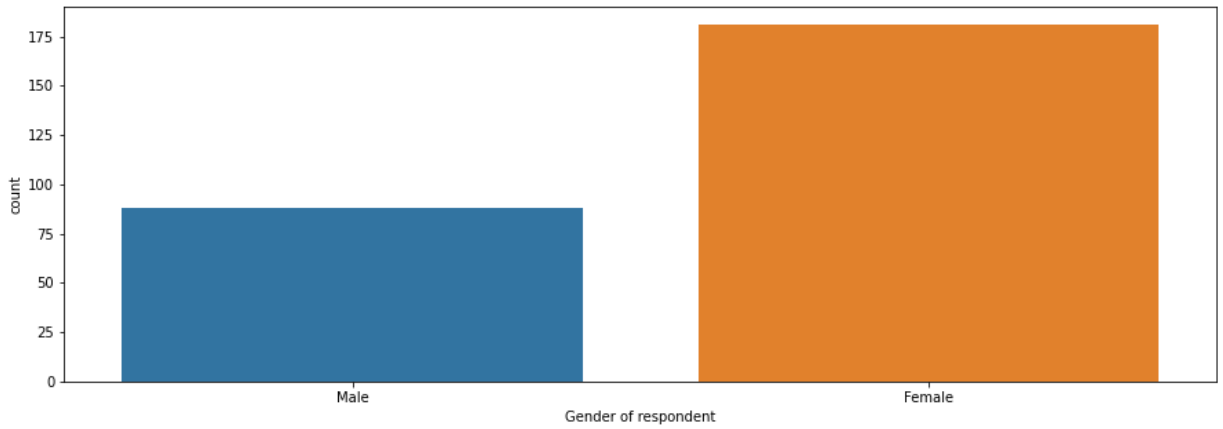
Out[10]:

	What is the Pin Code of where you shop online from?
count	269.000000
mean	220465.747212
std	140524.341051
min	110008.000000
25%	122018.000000
50%	201303.000000
75%	201310.000000
max	560037.000000

- As we have only 1 int variable, we have got description of one column only.

Data Visualization

In [11]:
```
plt.figure(figsize=(15,5),facecolor='white')
sns.countplot(df['Gender of respondent'])
plt.show()
df['Gender of respondent'].value_counts() , print(df['Gender of respondent'].valu
```




```
Female    0.672862
Male      0.327138
Name: Gender of respondent, dtype: float64
```

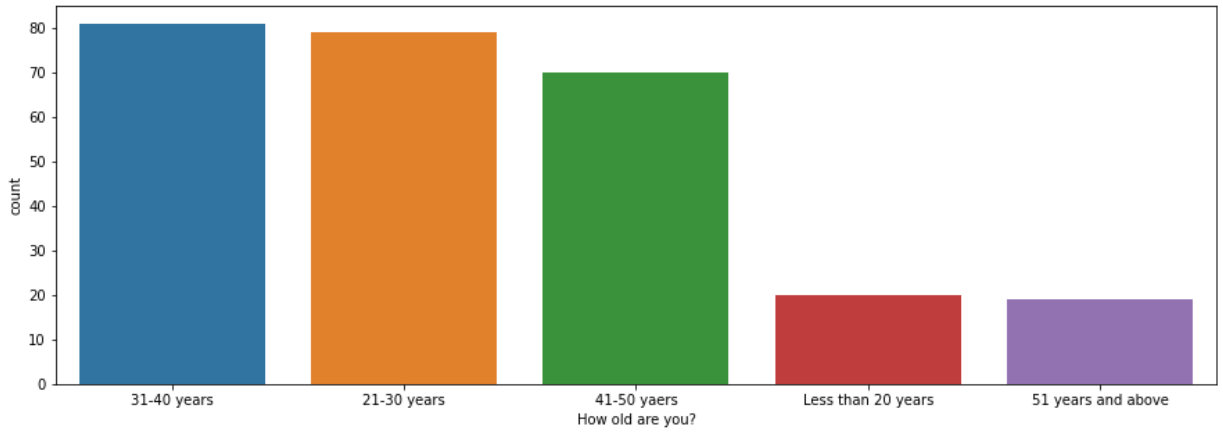
Out[11]:
```
(Female    181
 Male       88
 Name: Gender of respondent, dtype: int64,
 None)
```

In [99]:
```
df['How old are you?'].value_counts()
```

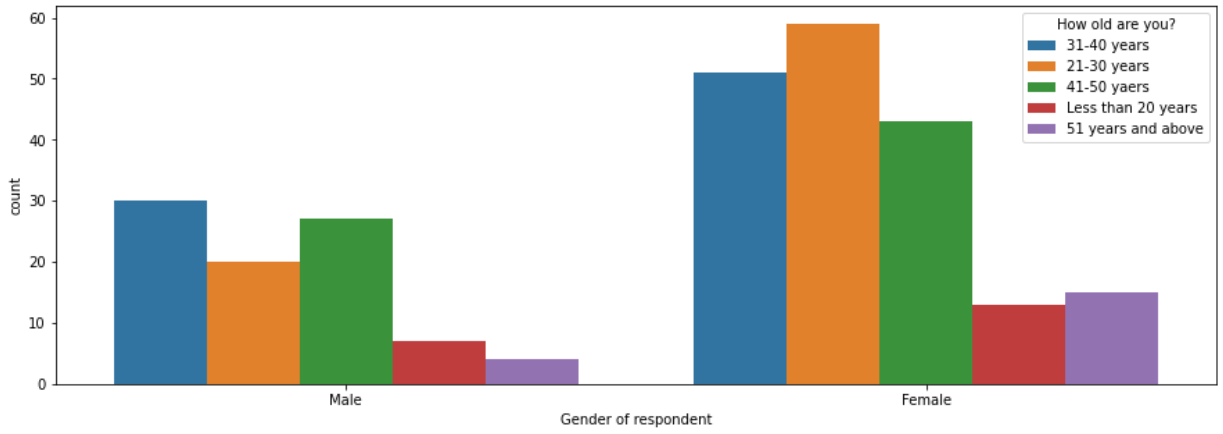
Out[99]:
```
1    81
0    79
2    70
4    20
3    19
Name: How old are you?, dtype: int64
```

In [12]:
```
plt.figure(figsize=(15,5),facecolor='white')
sns.countplot(df['How old are you?'])
```

Out[12]:
```
<AxesSubplot:xlabel='How old are you?', ylabel='count'>
```



In [13]:
```
plt.figure(figsize=(15,5),facecolor='white')
sns.countplot(hue='How old are you?',x='Gender of respondent',data=df)
plt.show()
```

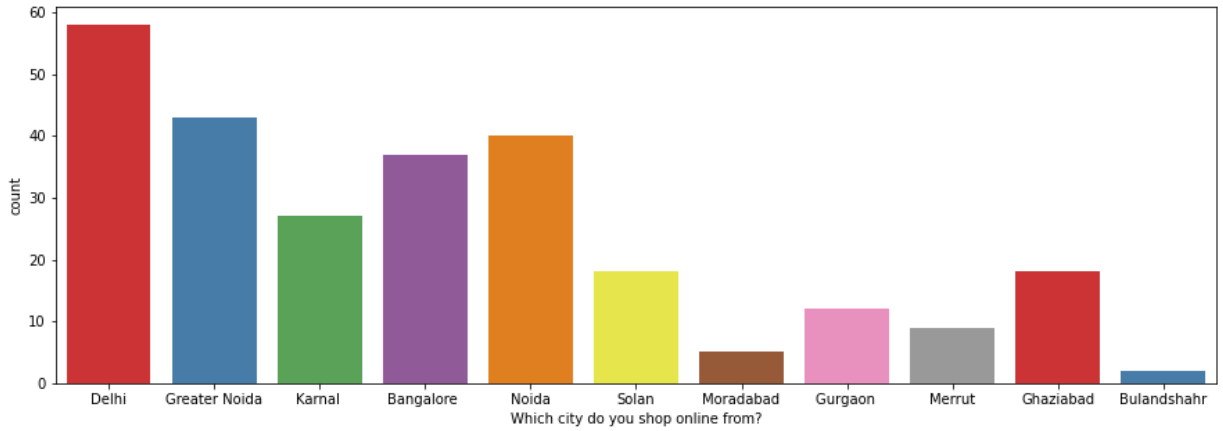


In [14]:
```
df['Which city do you shop online from?'].value_counts()
```

Out[14]:
```
Delhi            58
Greater Noida    43
Noida            40
Bangalore        37
Karnal           27
Solan            18
Ghaziabad        18
Gurgaon          12
Merrut            9
Moradabad         5
Bulandshahr       2
Name: Which city do you shop online from?, dtype: int64
```

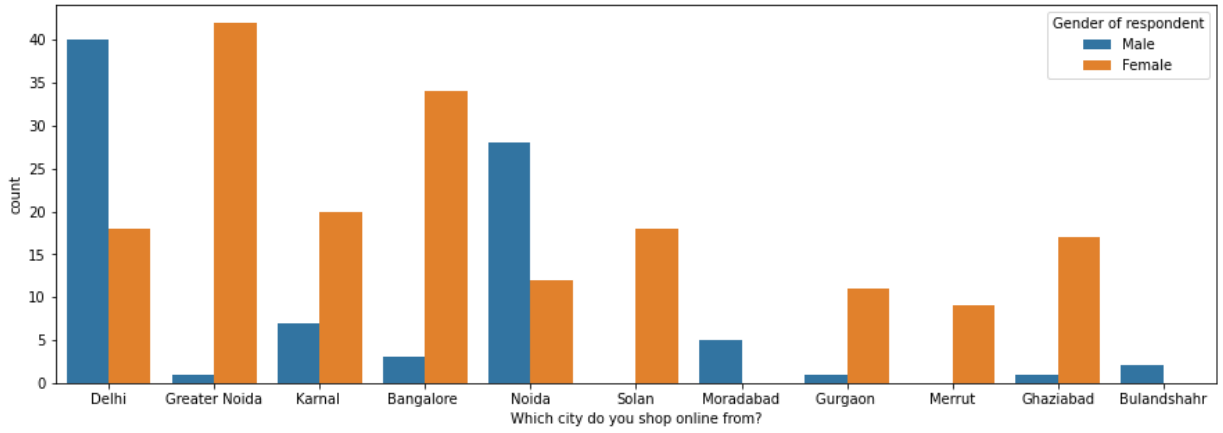
In [15]:
```
plt.figure(figsize=(15,5),facecolor='white')
sns.countplot(df['Which city do you shop online from?'], palette="Set1")
```

Out[15]:
```
<AxesSubplot:xlabel='Which city do you shop online from?', ylabel='count'>
```



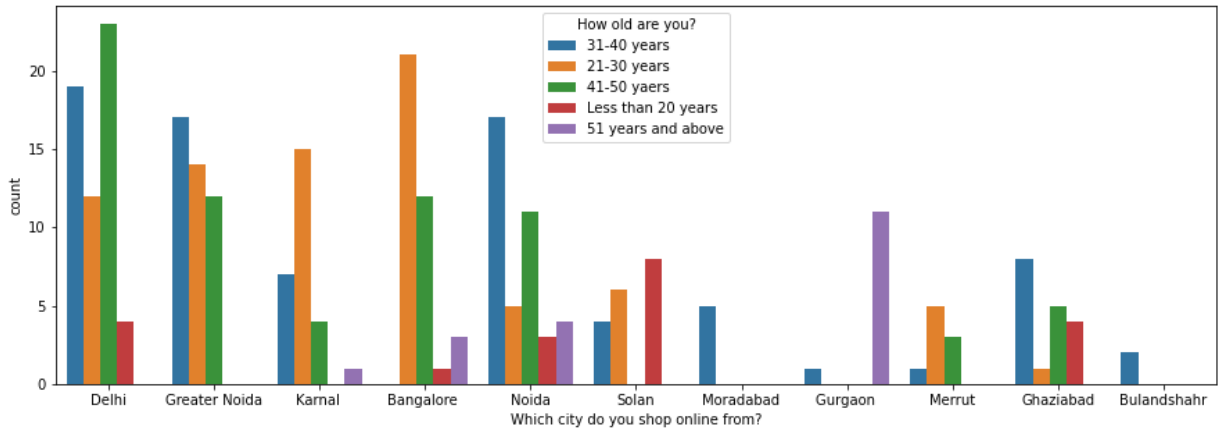
In [16]:
```
plt.figure(figsize=(15,5),facecolor='white')
sns.countplot(df['Which city do you shop online from?'], hue=df['Gender of respor
```

Out[16]:
```
<AxesSubplot:xlabel='Which city do you shop online from?', ylabel='count'>
```



In [17]:
```
plt.figure(figsize=(15,5))
sns.countplot(df['Which city do you shop online from?'],hue=df['How old are you?'
```

Out[17]:
```
<AxesSubplot:xlabel='Which city do you shop online from?', ylabel='count'>
```

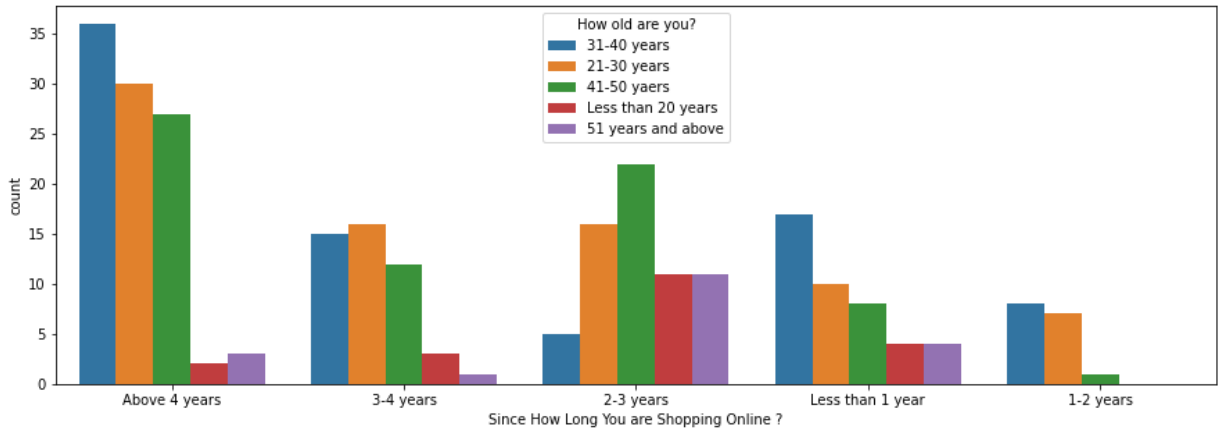


In [18]:
```
df['Since How Long You are Shopping Online ?'].value_counts()
```

Out[18]:
```
Above 4 years       98
2-3 years           65
3-4 years           47
Less than 1 year    43
1-2 years           16
Name: Since How Long You are Shopping Online ?, dtype: int64
```

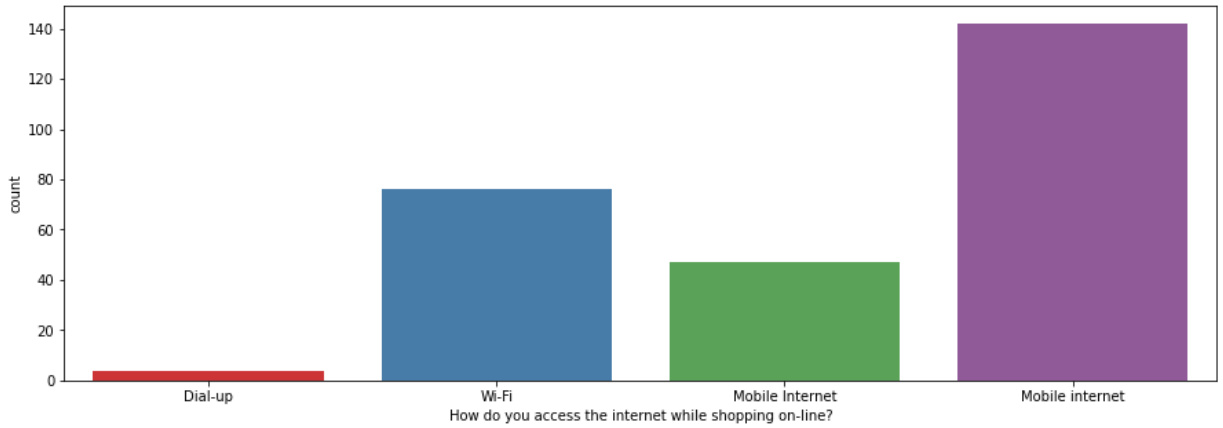
In [19]:
```
plt.figure(figsize=(15,5))
sns.countplot(df['Since How Long You are Shopping Online ?'],hue=df['How old are
```

Out[19]:
```
<AxesSubplot:xlabel='Since How Long You are Shopping Online ?', ylabel='count'>
```



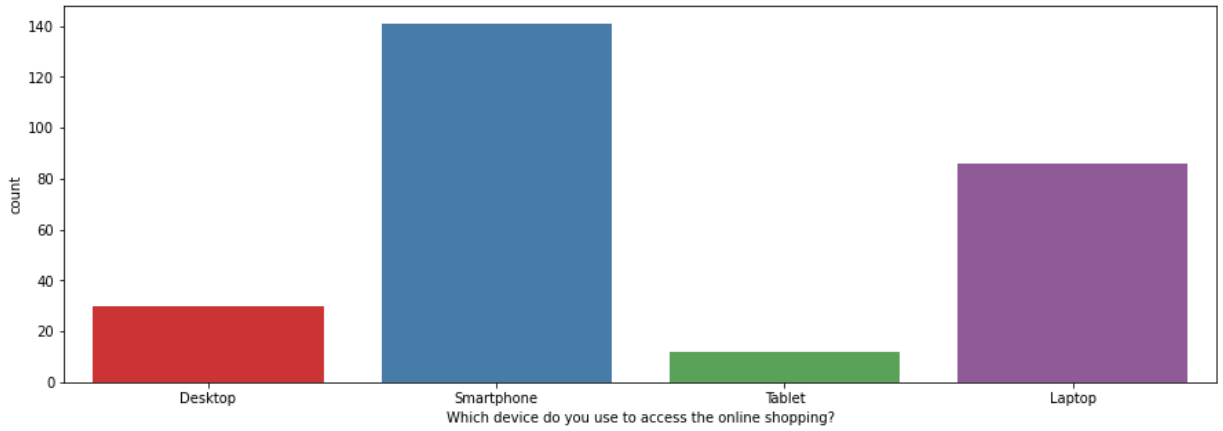
In [20]:
```
plt.figure(figsize=(15,5),facecolor='white')
sns.countplot(df['How do you access the internet while shopping on-line?'], palet
```

Out[20]:
```
<AxesSubplot:xlabel='How do you access the internet while shopping on-line?', y
label='count'>
```



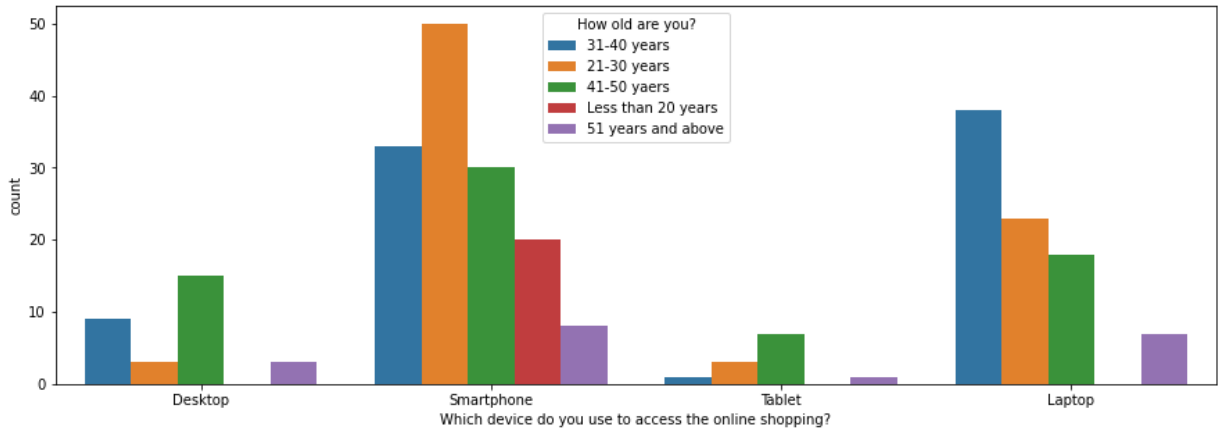
In [21]:
```
plt.figure(figsize=(15,5),facecolor='white')
sns.countplot(df['Which device do you use to access the online shopping?'], palet
```

Out[21]:
```
<AxesSubplot:xlabel='Which device do you use to access the online shopping?', y
label='count'>
```



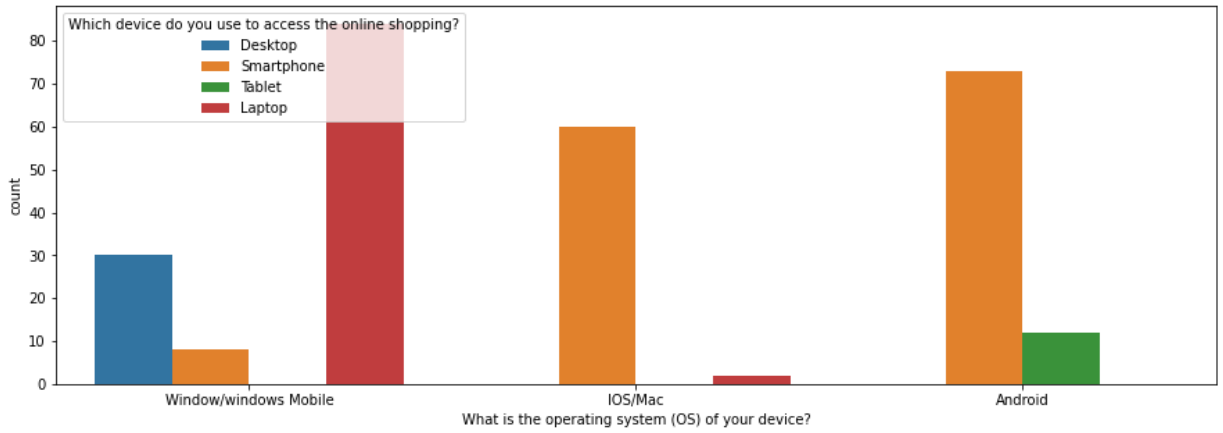
In [22]:
```
plt.figure(figsize=(15,5),facecolor='white')
sns.countplot(df['Which device do you use to access the online shopping?'], hue=d
```

Out[22]:
```
<AxesSubplot:xlabel='Which device do you use to access the online shopping?', y
label='count'>
```



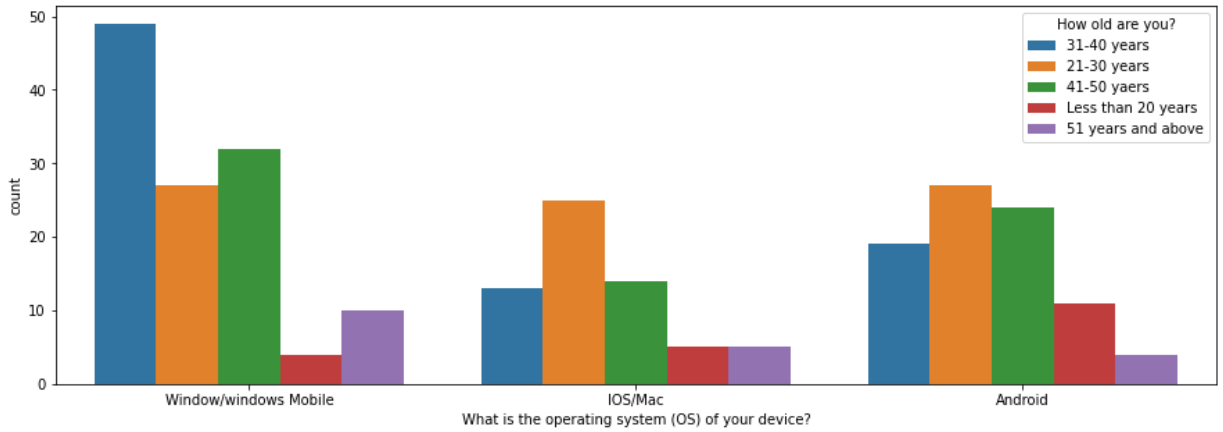
In [23]:
```
plt.figure(figsize=(15,5),facecolor='white')
sns.countplot(df['What is the operating system (OS) of your device?'], hue=df['Wh
```

Out[23]:
```
<AxesSubplot:xlabel='What is the operating system (OS) of your device?', ylabel
='count'>
```



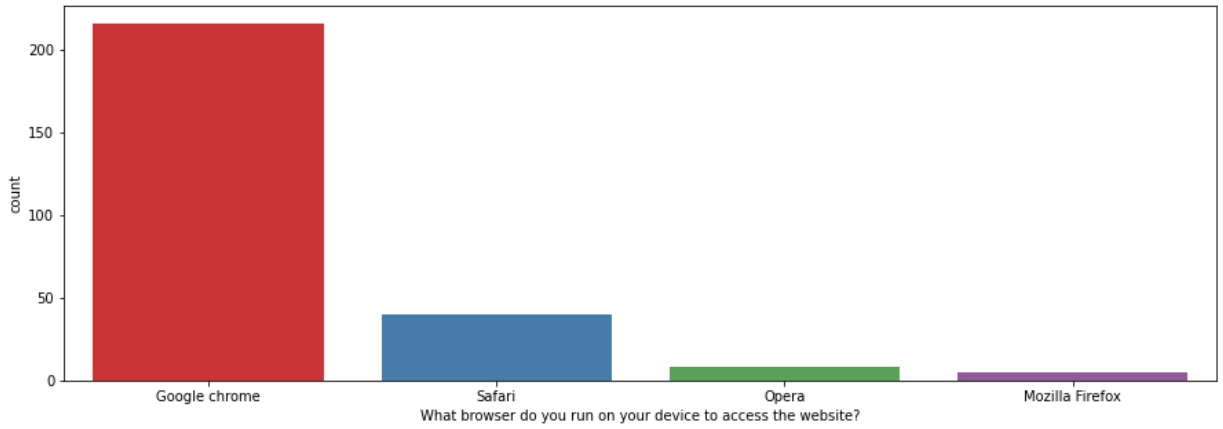
In [24]:
```
plt.figure(figsize=(15,5),facecolor='white')
sns.countplot(df['What is the operating system (OS) of your device?'], hue=df['Ho
```

Out[24]:
```
<AxesSubplot:xlabel='What is the operating system (OS) of your device?', ylabel
='count'>
```



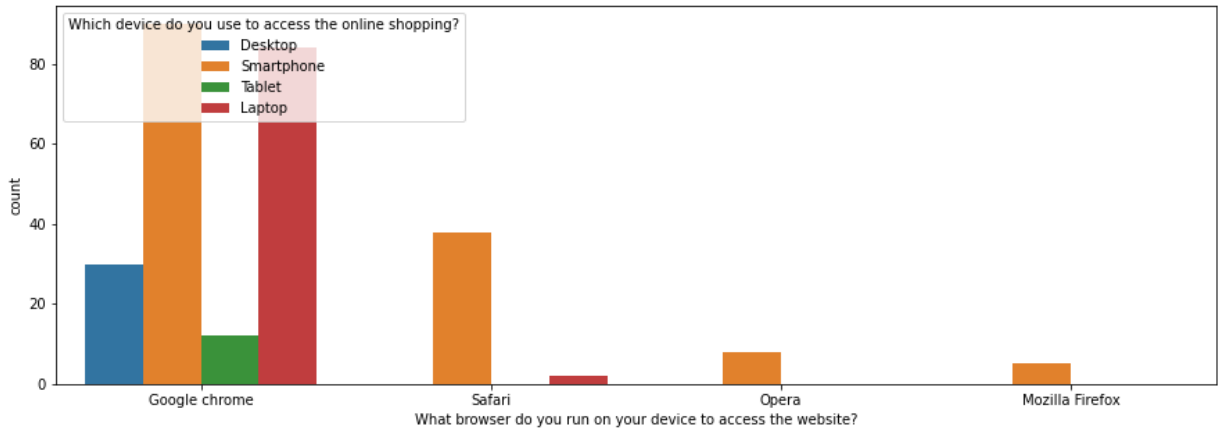
In [25]:
```
plt.figure(figsize=(15,5),facecolor='white')
sns.countplot(df['What browser do you run on your device to access the website?']
```

Out[25]:
```
<AxesSubplot:xlabel='What browser do you run on your device to access the websi
te?', ylabel='count'>
```



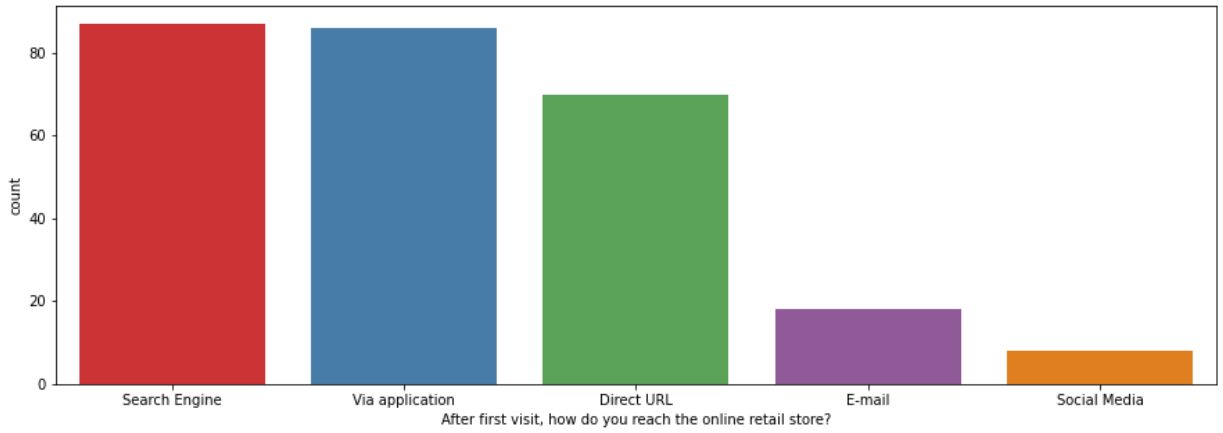
In [26]:
```
plt.figure(figsize=(15,5),facecolor='white')
sns.countplot(df['What browser do you run on your device to access the website?'])
```

Out[26]:
```
<AxesSubplot:xlabel='What browser do you run on your device to access the website?', ylabel='count'>
```



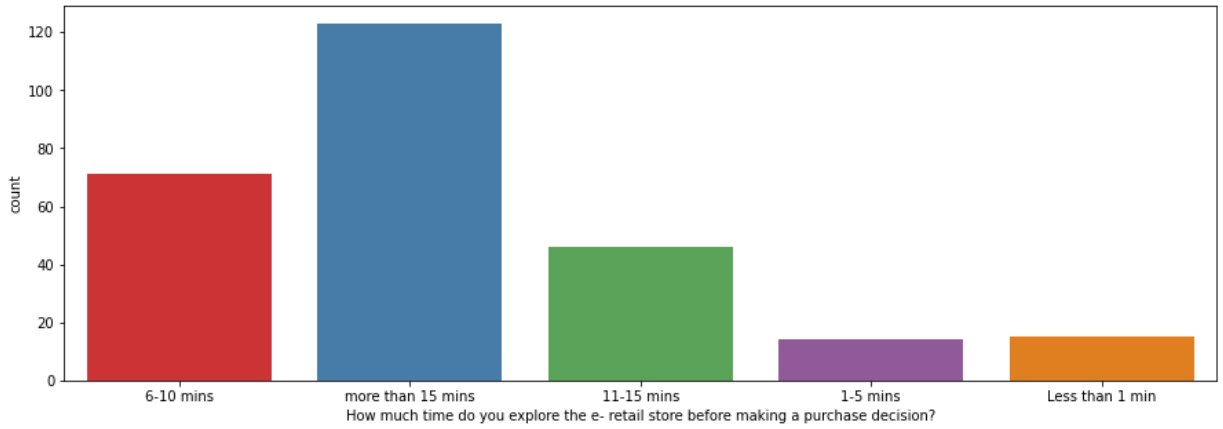
In [27]:
```
plt.figure(figsize=(15,5),facecolor='white')
sns.countplot(df['After first visit, how do you reach the online retail store?'],
```

Out[27]:
```
<AxesSubplot:xlabel='After first visit, how do you reach the online retail store?', ylabel='count'>
```



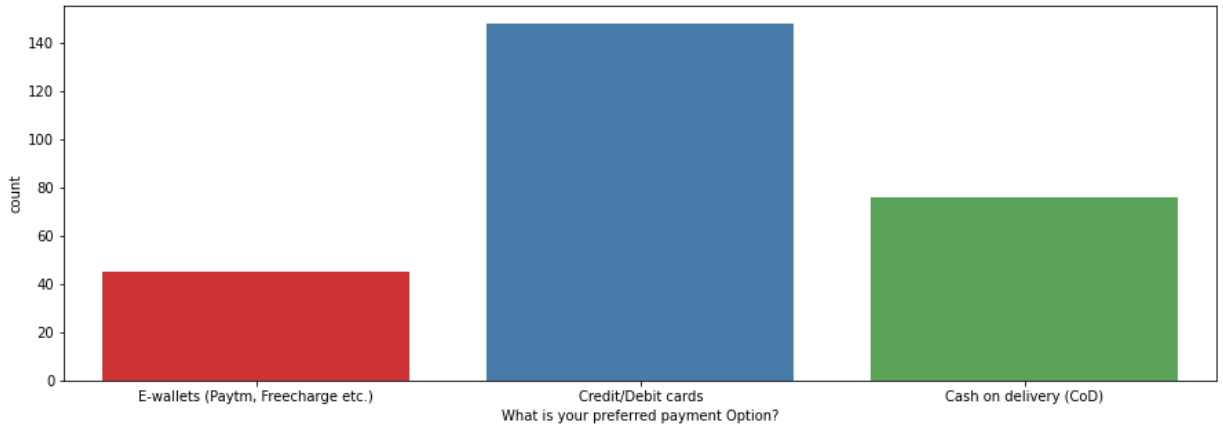
In [28]:
```
plt.figure(figsize=(15,5),facecolor='white')
sns.countplot(df['How much time do you explore the e- retail store before making
```

Out[28]:
```
<AxesSubplot:xlabel='How much time do you explore the e- retail store before ma
king a purchase decision?', ylabel='count'>
```



In [29]:
```
plt.figure(figsize=(15,5),facecolor='white')
sns.countplot(df['What is your preferred payment Option?'], palette="Set1")
```

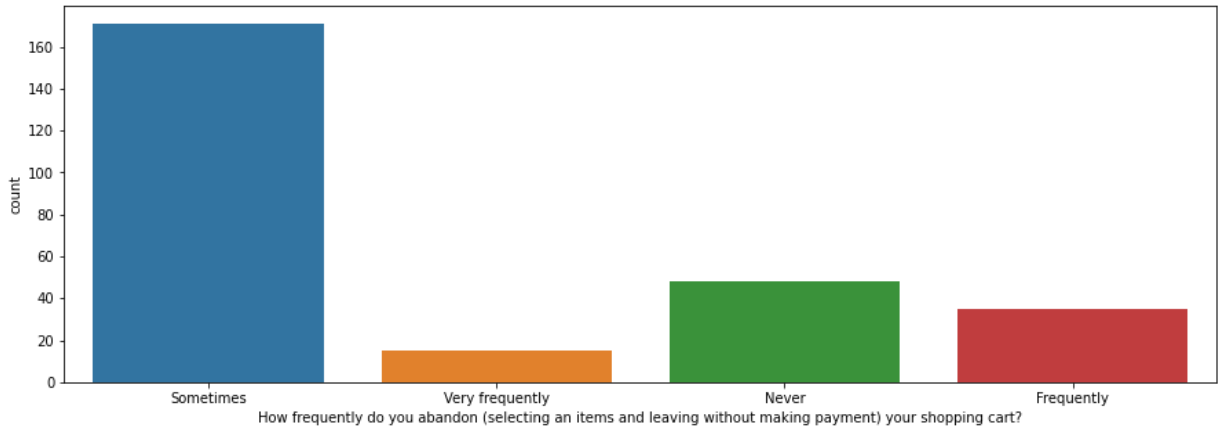
Out[29]:
```
<AxesSubplot:xlabel='What is your preferred payment Option?', ylabel='count'>
```



In [30]:
```
plt.figure(figsize=(15,5))
print(df['How frequently do you abandon (selecting an items and leaving without m
sns.countplot(df['How frequently do you abandon (selecting an items and leaving w
```

```
Sometimes          171
Never               48
Frequently          35
Very frequently     15
Name: How frequently do you abandon (selecting an items and leaving without mak
ing payment) your shopping cart?, dtype: int64
```

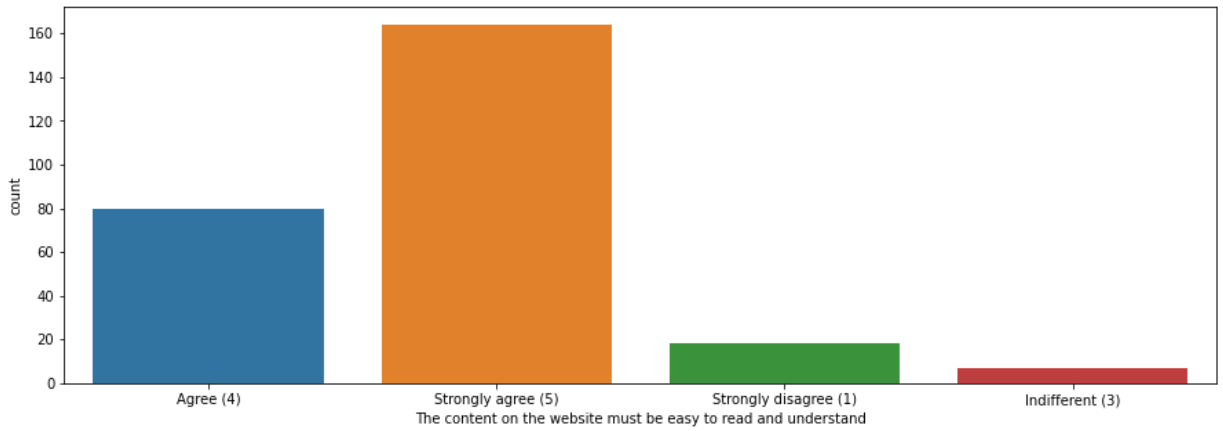
Out[30]:
```
<AxesSubplot:xlabel='How frequently do you abandon (selecting an items and leav
ing without making payment) your shopping cart?', ylabel='count'>
```



In [31]:
```
plt.figure(figsize=(15,5))
print(df['The content on the website must be easy to read and understand'].value_
sns.countplot(df['The content on the website must be easy to read and understand'
```

```
Strongly agree (5)       164
Agree (4)                 80
Strongly disagree (1)     18
Indifferent (3)            7
Name: The content on the website must be easy to read and understand, dtype: in
t64
```

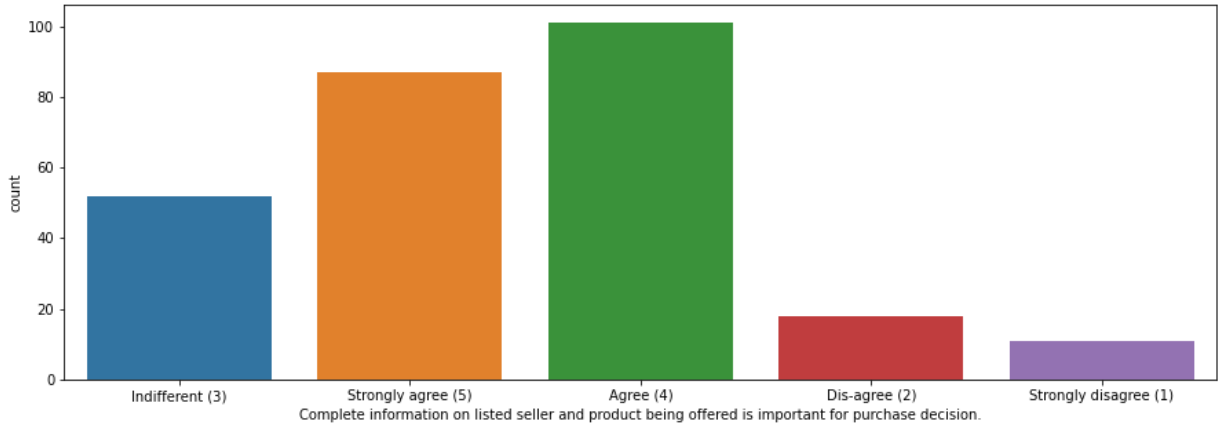
Out[31]:
```
<AxesSubplot:xlabel='The content on the website must be easy to read and unders
tand', ylabel='count'>
```



In [32]:
```
plt.figure(figsize=(15,5))
print(df['Complete information on listed seller and product being offered is impo
sns.countplot(df['Complete information on listed seller and product being offered
```

```
Agree (4)                101
Strongly agree (5)        87
Indifferent (3)           52
Dis-agree (2)             18
Strongly disagree (1)     11
Name: Complete information on listed seller and product being offered is import
ant for purchase decision., dtype: int64
```

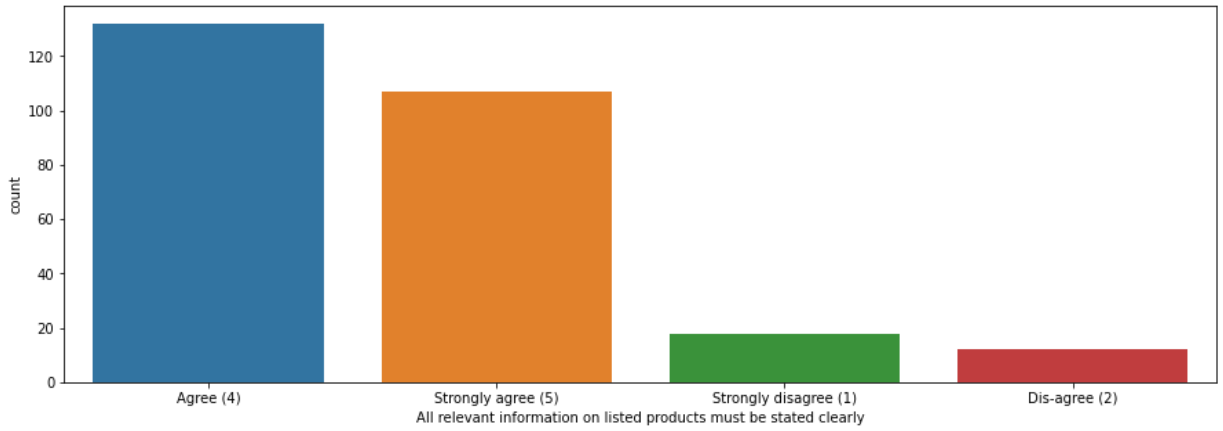
Out[32]:
```
<AxesSubplot:xlabel='Complete information on listed seller and product being of
fered is important for purchase decision.', ylabel='count'>
```



In [33]:
```
plt.figure(figsize=(15,5))
print(df['All relevant information on listed products must be stated clearly'].va
sns.countplot(df['All relevant information on listed products must be stated clea
```

```
Agree (4)                132
Strongly agree (5)       107
Strongly disagree (1)     18
Dis-agree (2)             12
Name: All relevant information on listed products must be stated clearly, dtyp
e: int64
```

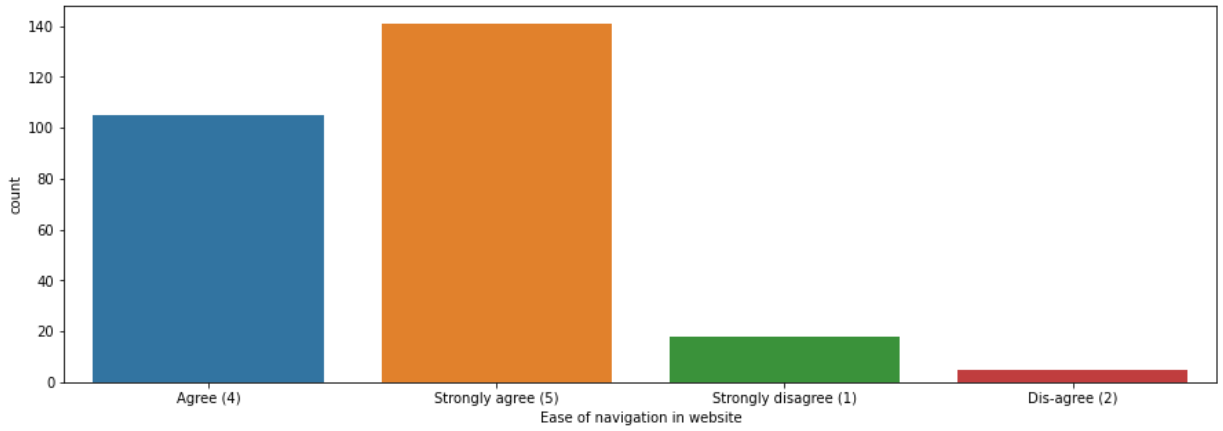
Out[33]:
```
<AxesSubplot:xlabel='All relevant information on listed products must be stated
clearly', ylabel='count'>
```



In [34]:
```
plt.figure(figsize=(15,5))
print(df['Ease of navigation in website'].value_counts())
sns.countplot(df['Ease of navigation in website'])
```

```
Strongly agree (5)       141
Agree (4)                105
Strongly disagree (1)     18
Dis-agree (2)              5
Name: Ease of navigation in website, dtype: int64
```

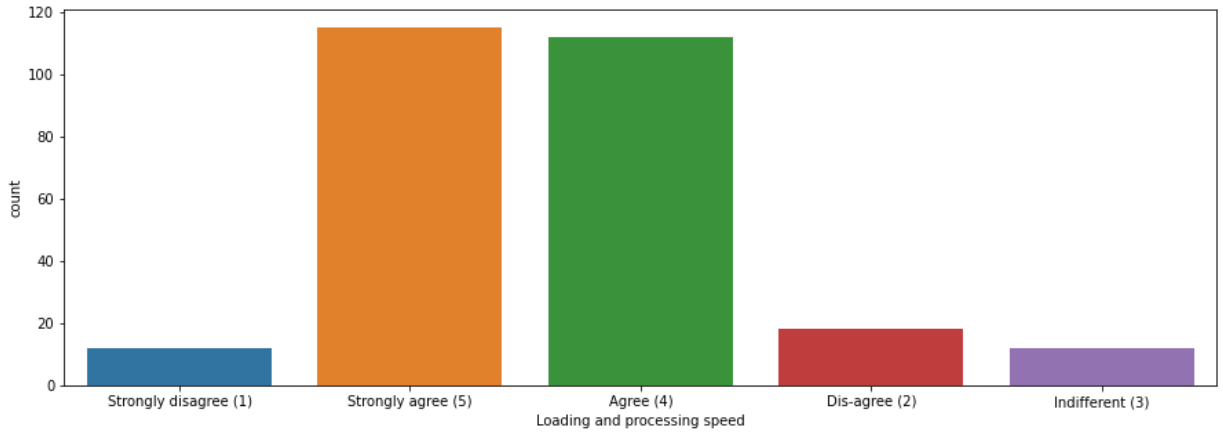
Out[34]:
```
<AxesSubplot:xlabel='Ease of navigation in website', ylabel='count'>
```



In [35]:
```
plt.figure(figsize=(15,5))
print(df['Loading and processing speed'].value_counts())
sns.countplot(df['Loading and processing speed'])
```

```
Strongly agree (5)       115
Agree (4)                112
Dis-agree (2)             18
Indifferent (3)           12
Strongly disagree (1)     12
Name: Loading and processing speed, dtype: int64
```

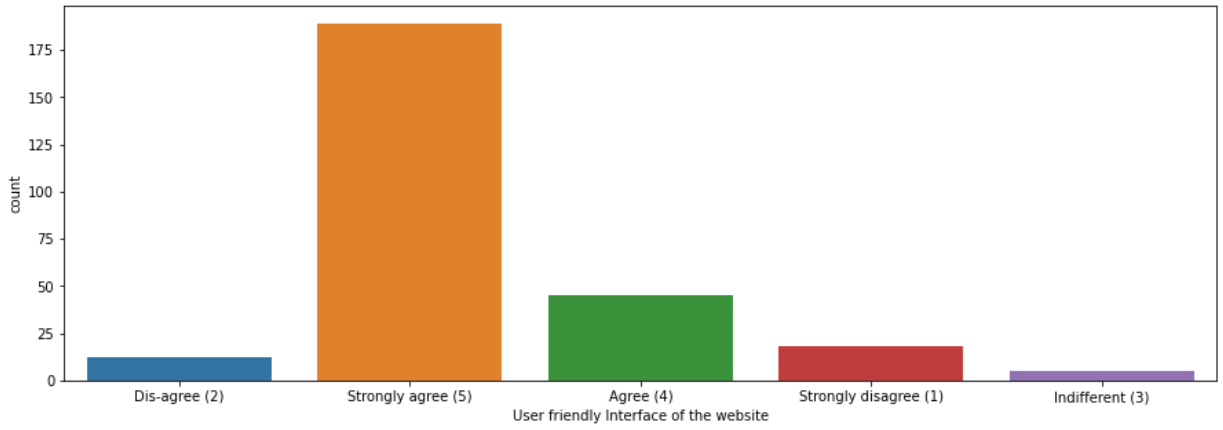
Out[35]: <AxesSubplot:xlabel='Loading and processing speed', ylabel='count'>



In [36]:
```
plt.figure(figsize=(15,5))
print(df['User friendly Interface of the website'].value_counts())
sns.countplot(df['User friendly Interface of the website'])
```

```
Strongly agree (5)       189
Agree (4)                 45
Strongly disagree (1)     18
Dis-agree (2)             12
Indifferent (3)            5
Name: User friendly Interface of the website, dtype: int64
```

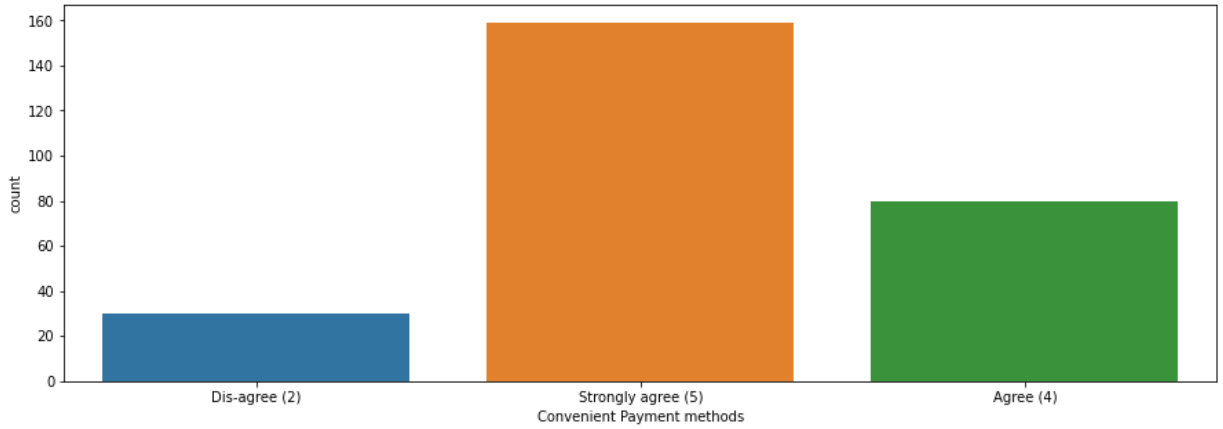
Out[36]: <AxesSubplot:xlabel='User friendly Interface of the website', ylabel='count'>



In [37]:
```
plt.figure(figsize=(15,5))
print(df['Convenient Payment methods'].value_counts())
sns.countplot(df['Convenient Payment methods'])
```

```
Strongly agree (5)    159
Agree (4)              80
Dis-agree (2)          30
Name: Convenient Payment methods, dtype: int64
```

Out[37]:
```
<AxesSubplot:xlabel='Convenient Payment methods', ylabel='count'>
```



In [38]:
```
plt.figure(figsize=(15,5))
print(df['Trust that the online retail store will fulfill its part of the transac
sns.countplot(df['Trust that the online retail store will fulfill its part of the
```

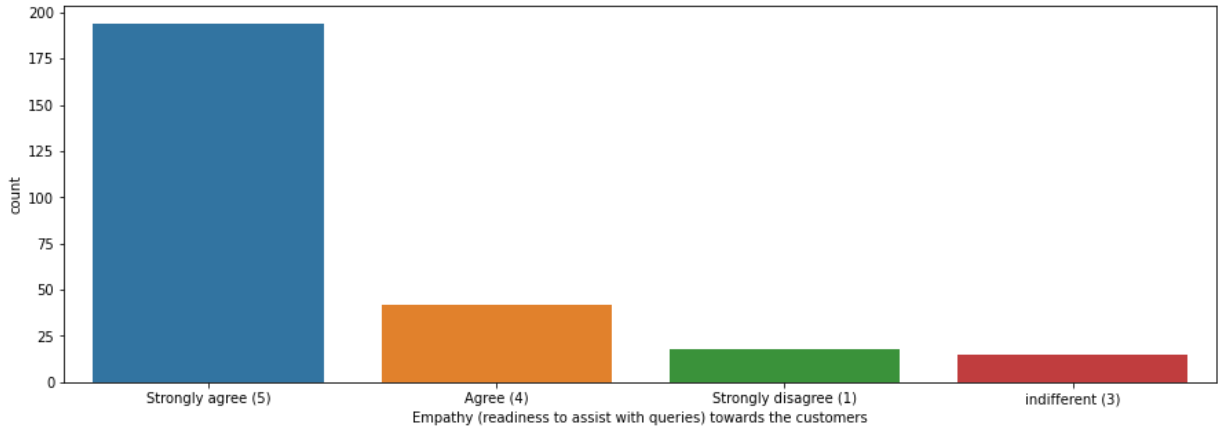
```
Strongly agree (5)    141
Agree (4)              86
Disagree (2)           30
indifferent  (3)       12
Name: Trust that the online retail store will fulfill its part of the transacti
on at the stipulated time, dtype: int64
```

Out[38]:
```
<AxesSubplot:xlabel='Trust that the online retail store will fulfill its part o
f the transaction at the stipulated time', ylabel='count'>
```

In [39]:
```
plt.figure(figsize=(15,5))
print(df['Empathy (readiness to assist with queries) towards the customers'].valu
sns.countplot(df['Empathy (readiness to assist with queries) towards the customer
```

```
Strongly agree (5)       194
Agree (4)                 42
Strongly disagree (1)     18
indifferent (3)           15
Name: Empathy (readiness to assist with queries) towards the customers, dtype:
int64
```

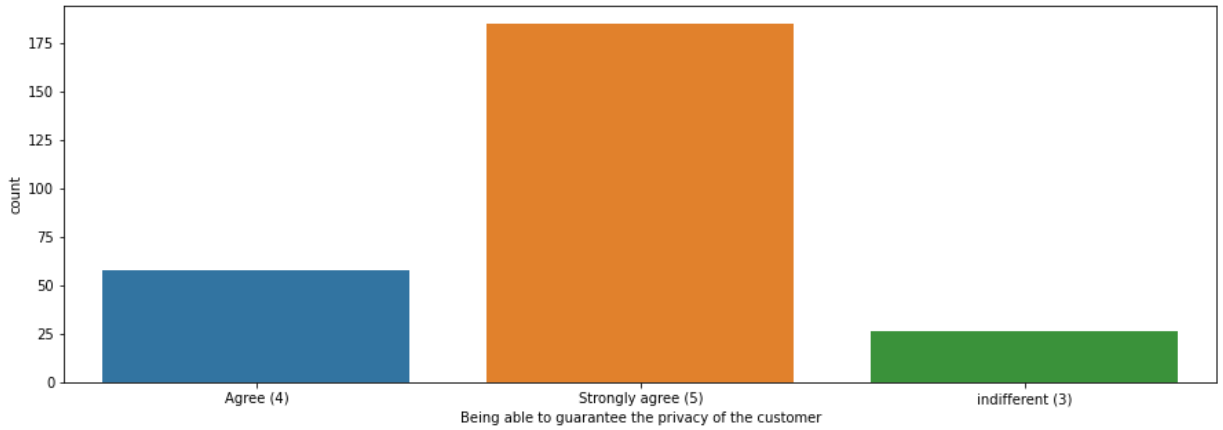
Out[39]:
```
<AxesSubplot:xlabel='Empathy (readiness to assist with queries) towards the cus
tomers', ylabel='count'>
```



In [40]:
```
plt.figure(figsize=(15,5))
print(df['Being able to guarantee the privacy of the customer'].value_counts())
sns.countplot(df['Being able to guarantee the privacy of the customer'])
```

```
Strongly agree (5)    185
Agree (4)              58
indifferent (3)        26
Name: Being able to guarantee the privacy of the customer, dtype: int64
```

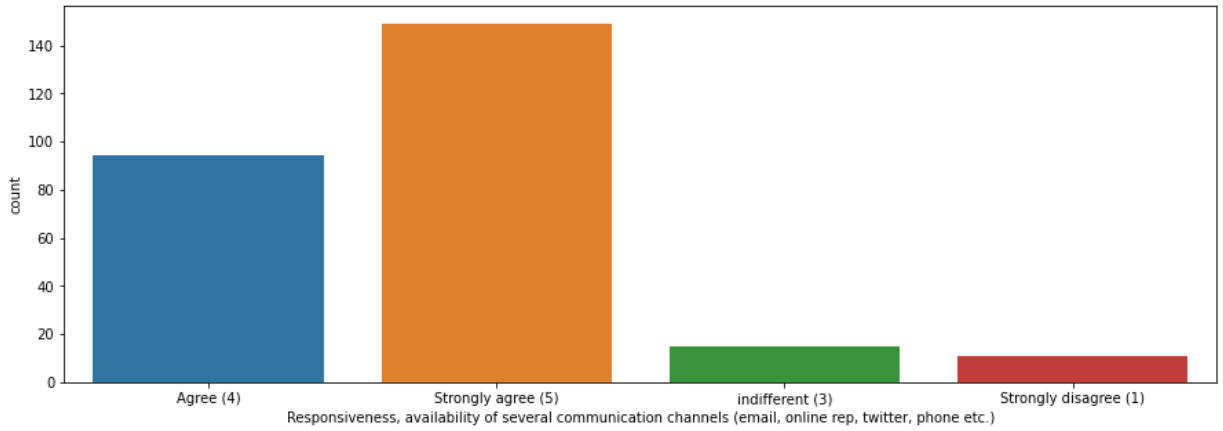
Out[40]:
```
<AxesSubplot:xlabel='Being able to guarantee the privacy of the customer', ylab
el='count'>
```



In [41]:
```
plt.figure(figsize=(15,5))
print(df['Responsiveness, availability of several communication channels (email,
sns.countplot(df['Responsiveness, availability of several communication channels
```

```
Strongly agree (5)       149
Agree (4)                 94
indifferent (3)           15
Strongly disagree (1)     11
Name: Responsiveness, availability of several communication channels (email, on
line rep, twitter, phone etc.), dtype: int64
```

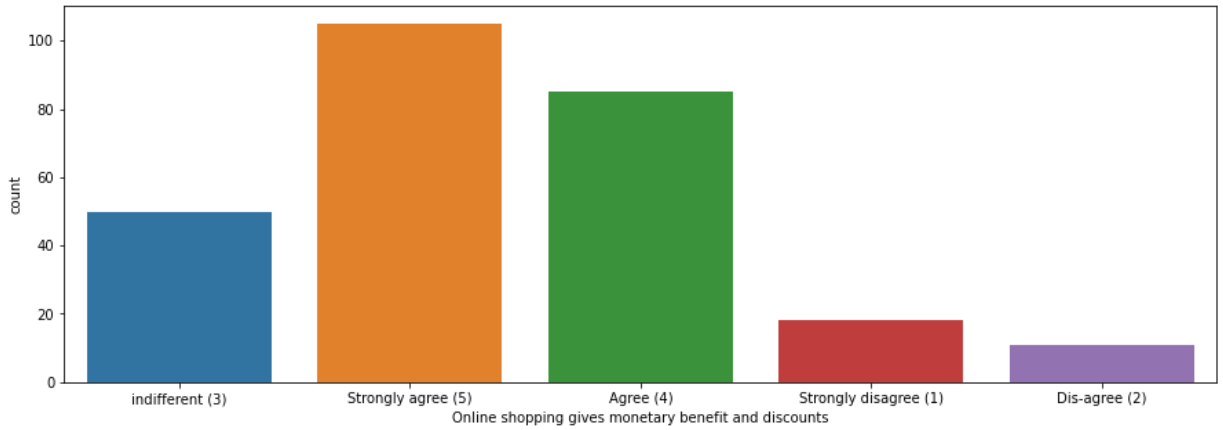
Out[41]:
```
<AxesSubplot:xlabel='Responsiveness, availability of several communication chan
nels (email, online rep, twitter, phone etc.)', ylabel='count'>
```



In [42]:
```
plt.figure(figsize=(15,5))
print(df['Online shopping gives monetary benefit and discounts'].value_counts())
sns.countplot(df['Online shopping gives monetary benefit and discounts'])
```

```
Strongly agree (5)       105
Agree (4)                 85
indifferent (3)           50
Strongly disagree (1)     18
Dis-agree (2)             11
Name: Online shopping gives monetary benefit and discounts, dtype: int64
```

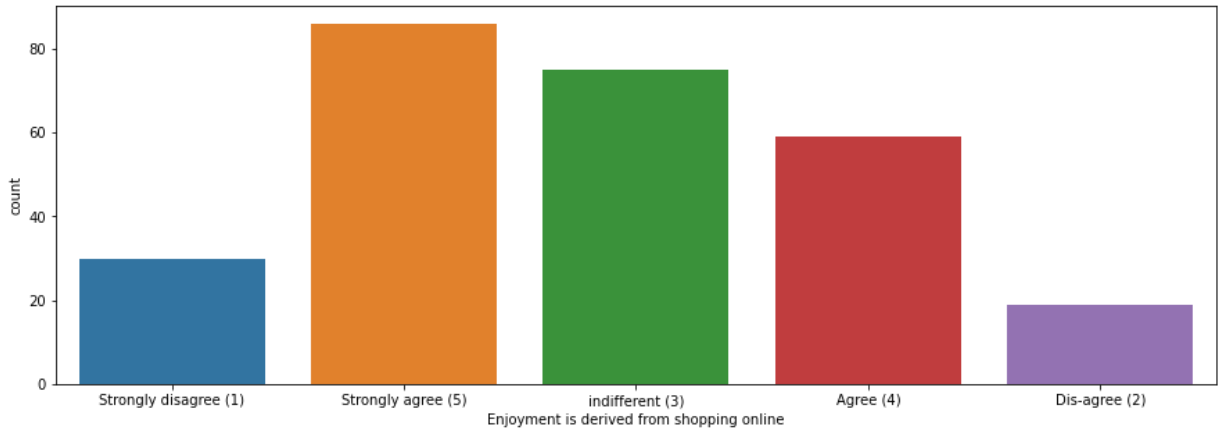
Out[42]:
```
<AxesSubplot:xlabel='Online shopping gives monetary benefit and discounts', yla
bel='count'>
```



In [43]:
```
plt.figure(figsize=(15,5))
print(df['Enjoyment is derived from shopping online'].value_counts())
sns.countplot(df['Enjoyment is derived from shopping online'])
```

```
Strongly agree (5)       86
indifferent (3)          75
Agree (4)                59
Strongly disagree (1)    30
Dis-agree (2)            19
Name: Enjoyment is derived from shopping online, dtype: int64
```

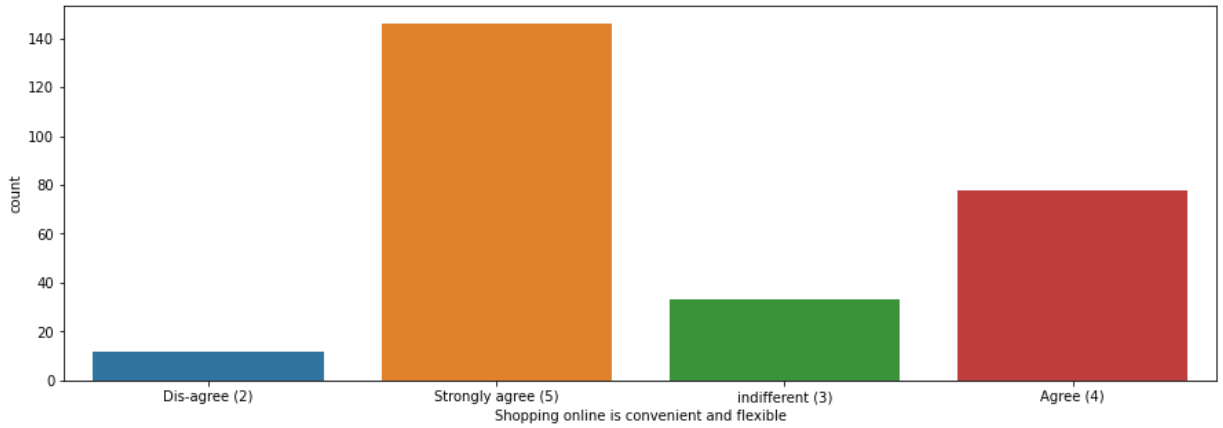
Out[43]:
```
<AxesSubplot:xlabel='Enjoyment is derived from shopping online', ylabel='coun
t'>
```



In [44]:
```
plt.figure(figsize=(15,5))
print(df['Shopping online is convenient and flexible'].value_counts())
sns.countplot(df['Shopping online is convenient and flexible'])
```

```
Strongly agree (5)    146
Agree (4)              78
indifferent (3)        33
Dis-agree (2)          12
Name: Shopping online is convenient and flexible, dtype: int64
```

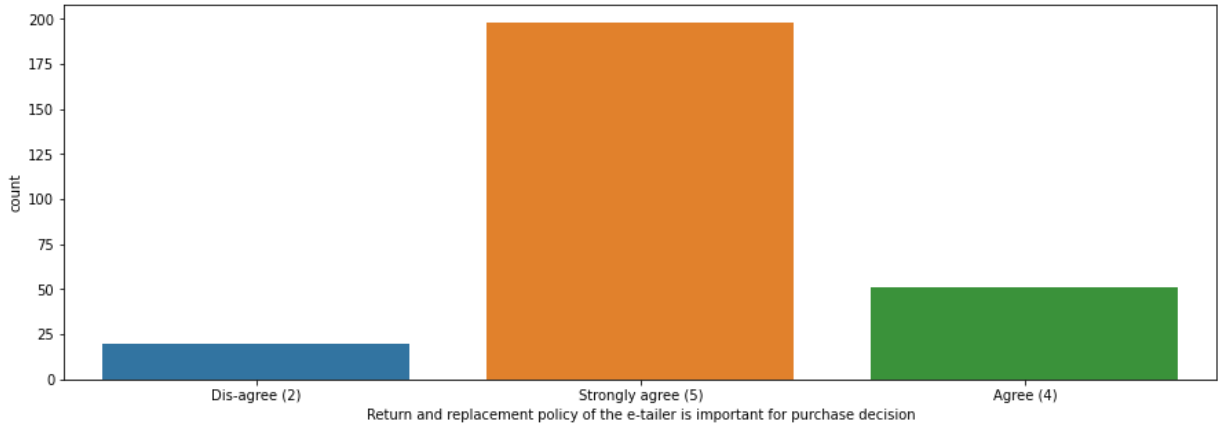
Out[44]:
```
<AxesSubplot:xlabel='Shopping online is convenient and flexible', ylabel='coun
t'>
```



In [45]:
```
plt.figure(figsize=(15,5))
print(df['Return and replacement policy of the e-tailer is important for purchase
sns.countplot(df['Return and replacement policy of the e-tailer is important for
```

```
Strongly agree (5)    198
Agree (4)              51
Dis-agree (2)          20
Name: Return and replacement policy of the e-tailer is important for purchase d
ecision, dtype: int64
```

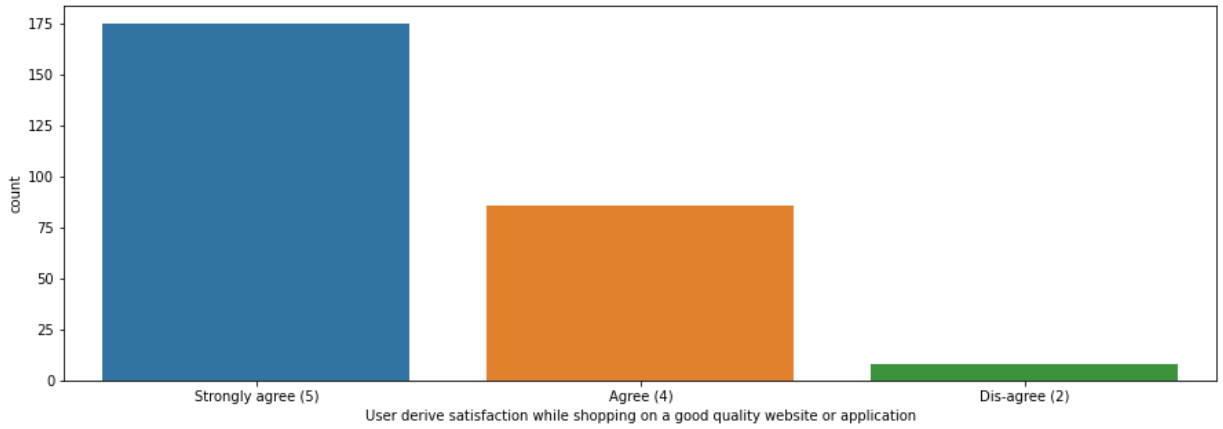
Out[45]:
```
<AxesSubplot:xlabel='Return and replacement policy of the e-tailer is important
for purchase decision', ylabel='count'>
```



In [46]:
```
plt.figure(figsize=(15,5))
print(df['User derive satisfaction while shopping on a good quality website or ap
sns.countplot(df['User derive satisfaction while shopping on a good quality websi
```

```
Strongly agree (5)    175
Agree (4)              86
Dis-agree (2)           8
Name: User derive satisfaction while shopping on a good quality website or appl
ication, dtype: int64
```

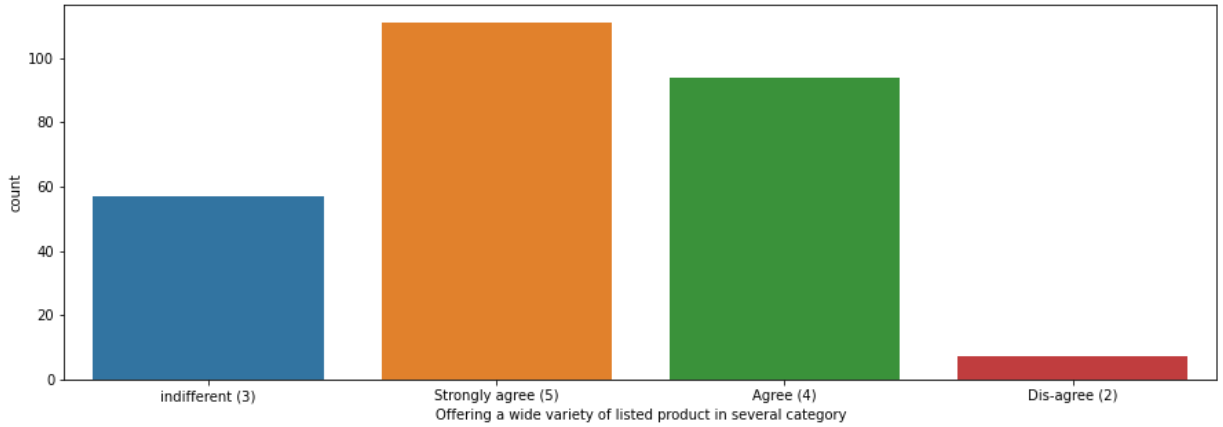
Out[46]:
```
<AxesSubplot:xlabel='User derive satisfaction while shopping on a good quality
website or application', ylabel='count'>
```



In [47]:
```
plt.figure(figsize=(15,5))
print(df['Offering a wide variety of listed product in several category'].value_c
sns.countplot(df['Offering a wide variety of listed product in several category']
```

```
Strongly agree (5)    111
Agree (4)              94
indifferent (3)        57
Dis-agree (2)           7
Name: Offering a wide variety of listed product in several category, dtype: int
64
```

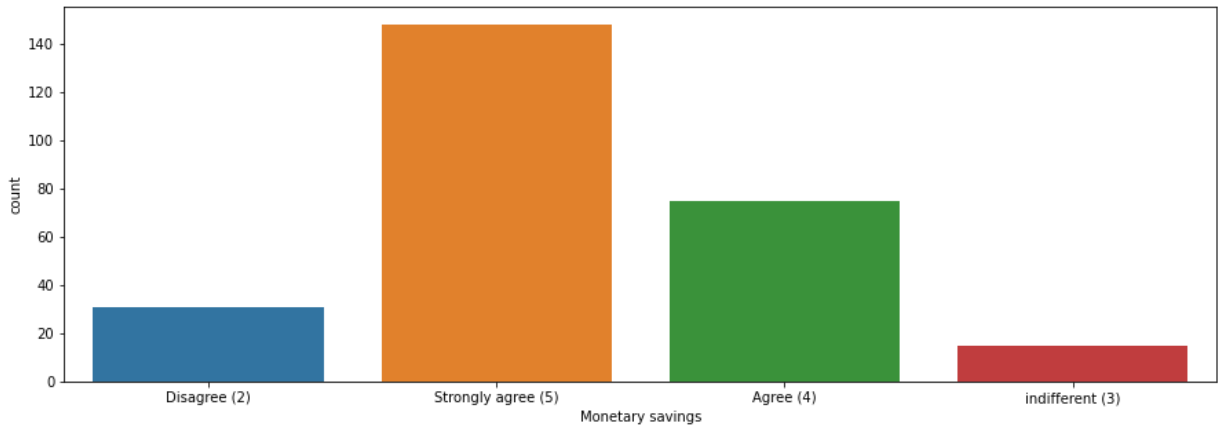
Out[47]:
```
<AxesSubplot:xlabel='Offering a wide variety of listed product in several categ
ory', ylabel='count'>
```



In [48]:
```
plt.figure(figsize=(15,5))
print(df['Monetary savings'].value_counts())
sns.countplot(df['Monetary savings'])
```

```
Strongly agree (5)    148
Agree (4)              75
Disagree (2)           31
indifferent (3)        15
Name: Monetary savings, dtype: int64
```

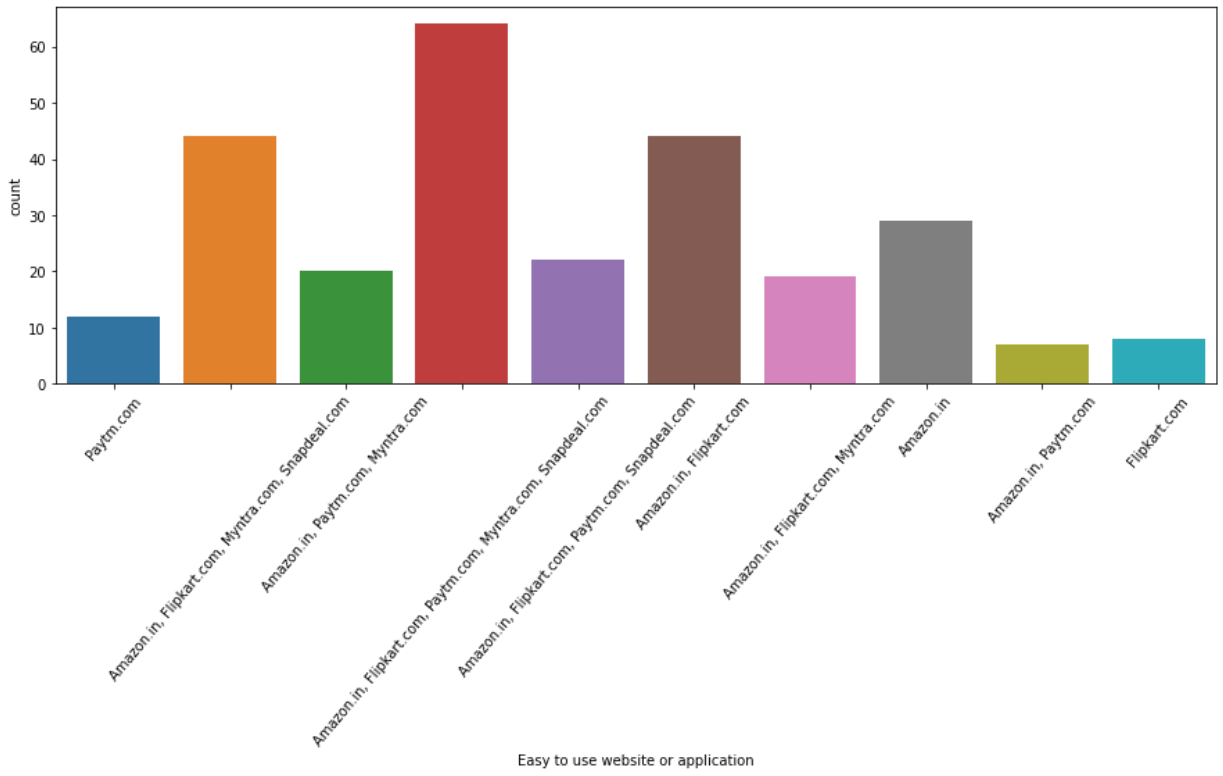
Out[48]:
```
<AxesSubplot:xlabel='Monetary savings', ylabel='count'>
```



In [49]:
```
plt.figure(figsize=(15,5))
plt.xticks(rotation=50)
print(df['Easy to use website or application'].value_counts())
sns.countplot(df['Easy to use website or application'])
```

```
Amazon.in, Flipkart.com, Paytm.com, Myntra.com, Snapdeal.com    64
Amazon.in, Flipkart.com, Myntra.com, Snapdeal.com               44
Amazon.in, Flipkart.com                                         44
Amazon.in                                                       29
Amazon.in, Flipkart.com, Paytm.com, Snapdeal.com                22
Amazon.in, Paytm.com, Myntra.com                                20
Amazon.in, Flipkart.com, Myntra.com                             19
Paytm.com                                                       12
Flipkart.com                                                     8
Amazon.in, Paytm.com                                             7
Name: Easy to use website or application, dtype: int64
```

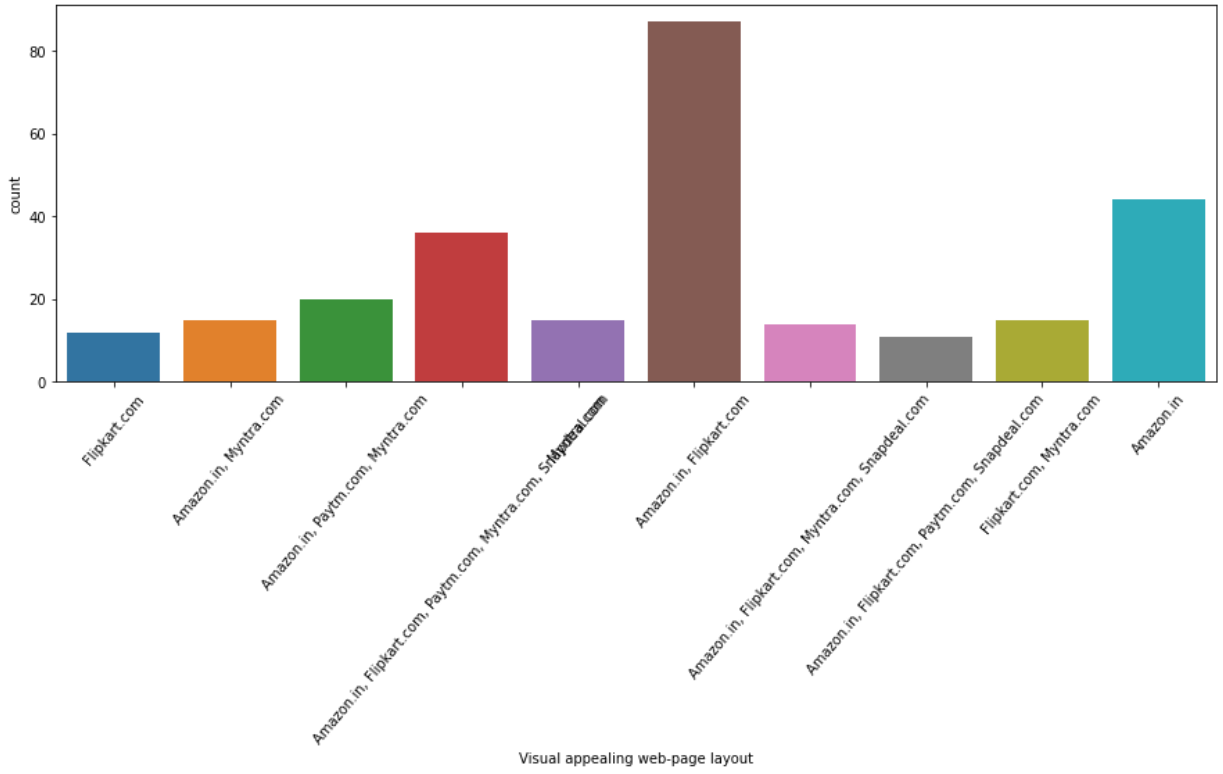
Out[49]: <AxesSubplot:xlabel='Easy to use website or application', ylabel='count'>



In [50]:
```
plt.figure(figsize=(15,5))
plt.xticks(rotation=50)
print(df['Visual appealing web-page layout'].value_counts())
sns.countplot(df['Visual appealing web-page layout'])
```

```
Amazon.in, Flipkart.com                                                 87
Amazon.in                                                               44
Amazon.in, Flipkart.com, Paytm.com, Myntra.com, Snapdeal.com            36
Amazon.in, Paytm.com, Myntra.com                                        20
Myntra.com                                                              15
Amazon.in, Myntra.com                                                   15
Flipkart.com, Myntra.com                                                15
Amazon.in, Flipkart.com, Myntra.com, Snapdeal.com                       14
Flipkart.com                                                            12
Amazon.in, Flipkart.com, Paytm.com, Snapdeal.com                        11
Name: Visual appealing web-page layout, dtype: int64
```

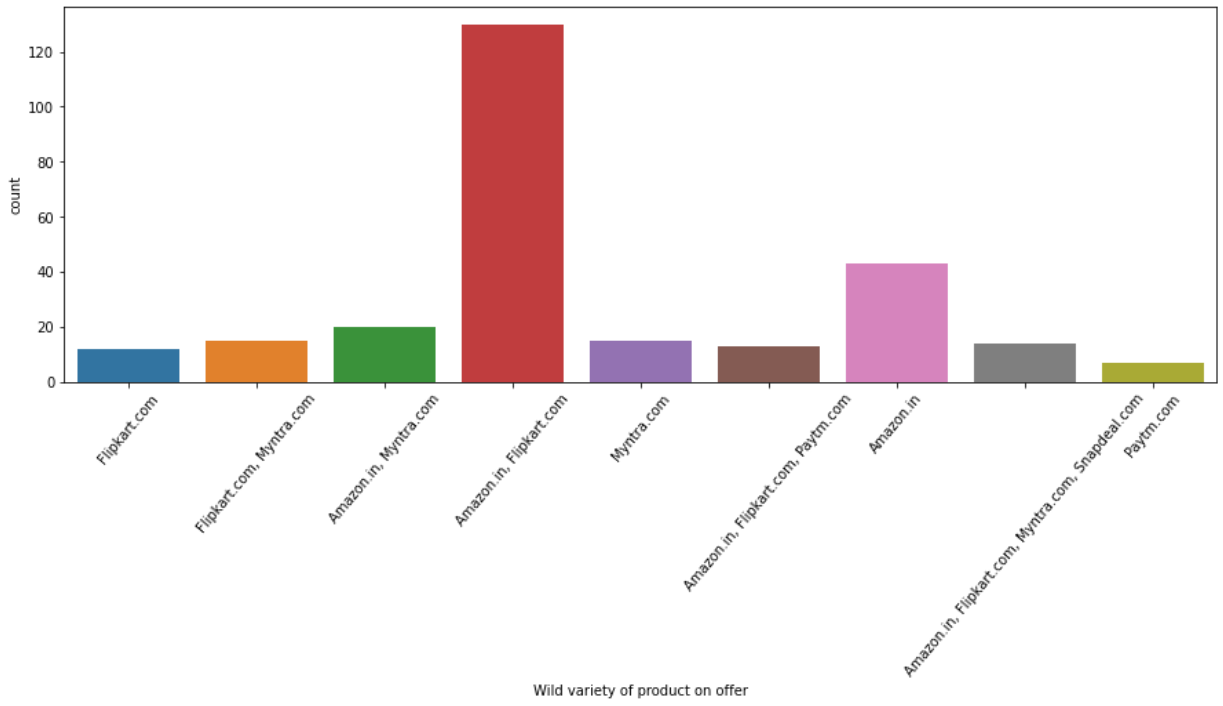
Out[50]: <AxesSubplot:xlabel='Visual appealing web-page layout', ylabel='count'>



In [51]:
```
plt.figure(figsize=(15,5))
plt.xticks(rotation=50)
print(df['Wild variety of product on offer'].value_counts())
sns.countplot(df['Wild variety of product on offer'])
```

```
Amazon.in, Flipkart.com                                  130
Amazon.in                                                 43
Amazon.in, Myntra.com                                     20
Myntra.com                                                15
Flipkart.com, Myntra.com                                  15
Amazon.in, Flipkart.com, Myntra.com, Snapdeal.com         14
Amazon.in, Flipkart.com, Paytm.com                        13
Flipkart.com                                              12
Paytm.com                                                  7
Name: Wild variety of product on offer, dtype: int64
```

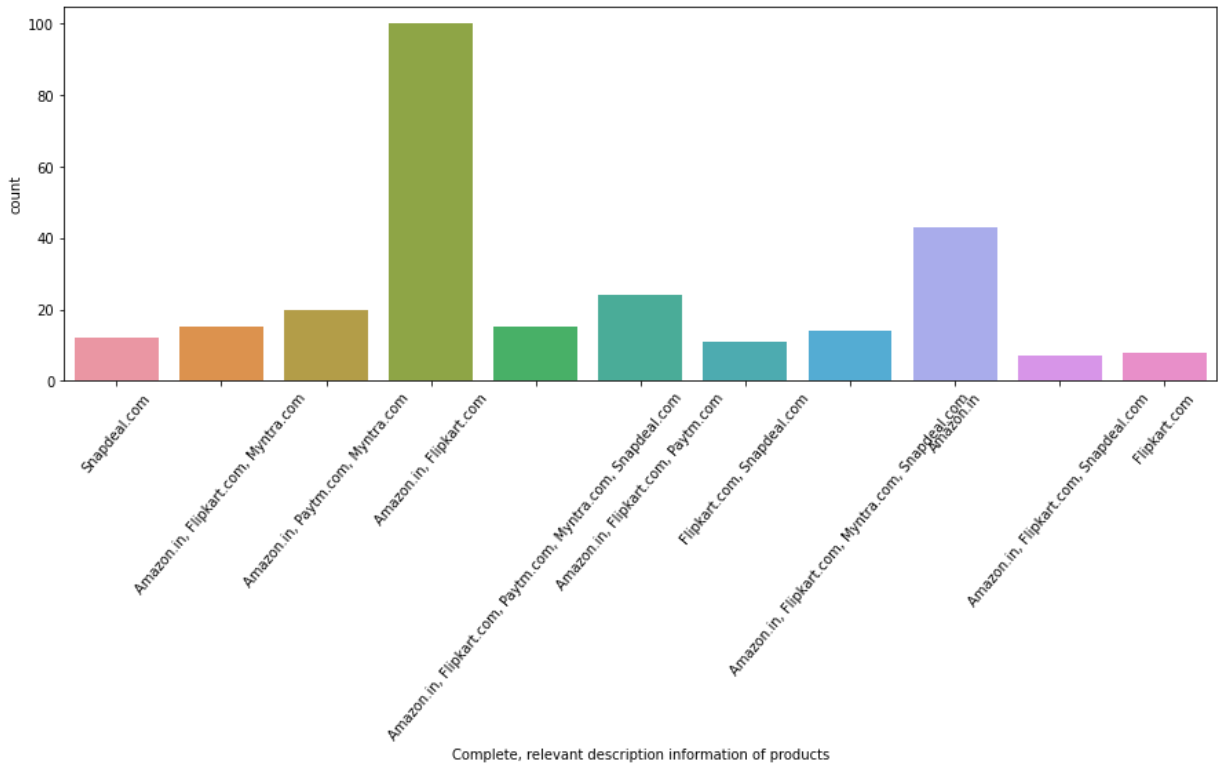
Out[51]: <AxesSubplot:xlabel='Wild variety of product on offer', ylabel='count'>



In [52]:
```
plt.figure(figsize=(15,5))
plt.xticks(rotation=50)
print(df['Complete, relevant description information of products'].value_counts()
sns.countplot(df['Complete, relevant description information of products'])
```

```
Amazon.in, Flipkart.com                                          100
Amazon.in                                                         43
Amazon.in, Flipkart.com, Paytm.com                                24
Amazon.in, Paytm.com, Myntra.com                                  20
Amazon.in, Flipkart.com, Paytm.com, Myntra.com, Snapdeal.com      15
Amazon.in, Flipkart.com, Myntra.com                               15
Amazon.in, Flipkart.com, Myntra.com, Snapdeal.com                 14
Snapdeal.com                                                      12
Flipkart.com, Snapdeal.com                                        11
Flipkart.com                                                       8
Amazon.in, Flipkart.com, Snapdeal.com                              7
Name: Complete, relevant description information of products, dtype: int64
```

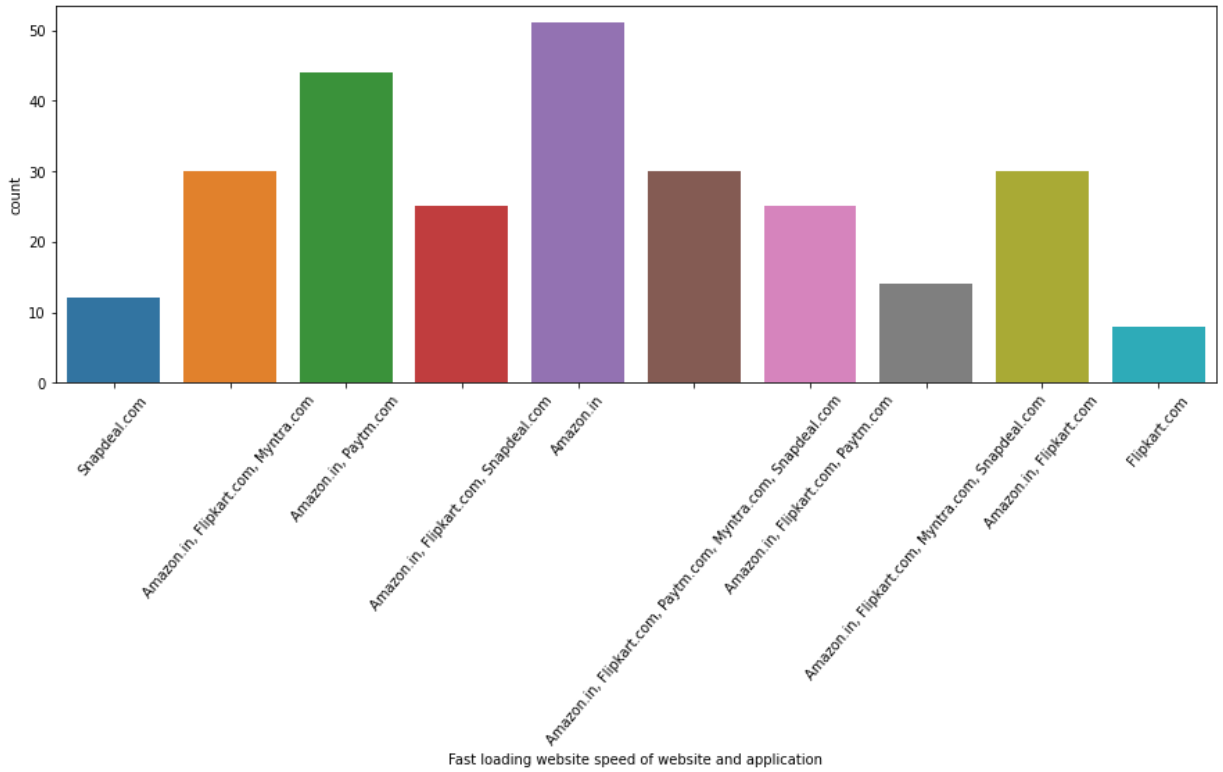
Out[52]:
```
<AxesSubplot:xlabel='Complete, relevant description information of products', y
label='count'>
```



In [53]:
```
plt.figure(figsize=(15,5))
plt.xticks(rotation=50)
print(df['Fast loading website speed of website and application'].value_counts())
sns.countplot(df['Fast loading website speed of website and application'])
```

```
Amazon.in                                                          51
Amazon.in, Paytm.com                                               44
Amazon.in, Flipkart.com, Paytm.com, Myntra.com, Snapdeal.com       30
Amazon.in, Flipkart.com, Myntra.com                                30
Amazon.in, Flipkart.com                                            30
Amazon.in, Flipkart.com, Snapdeal.com                              25
Amazon.in, Flipkart.com, Paytm.com                                 25
Amazon.in, Flipkart.com, Myntra.com, Snapdeal.com                  14
Snapdeal.com                                                       12
Flipkart.com                                                        8
Name: Fast loading website speed of website and application, dtype: int64
```

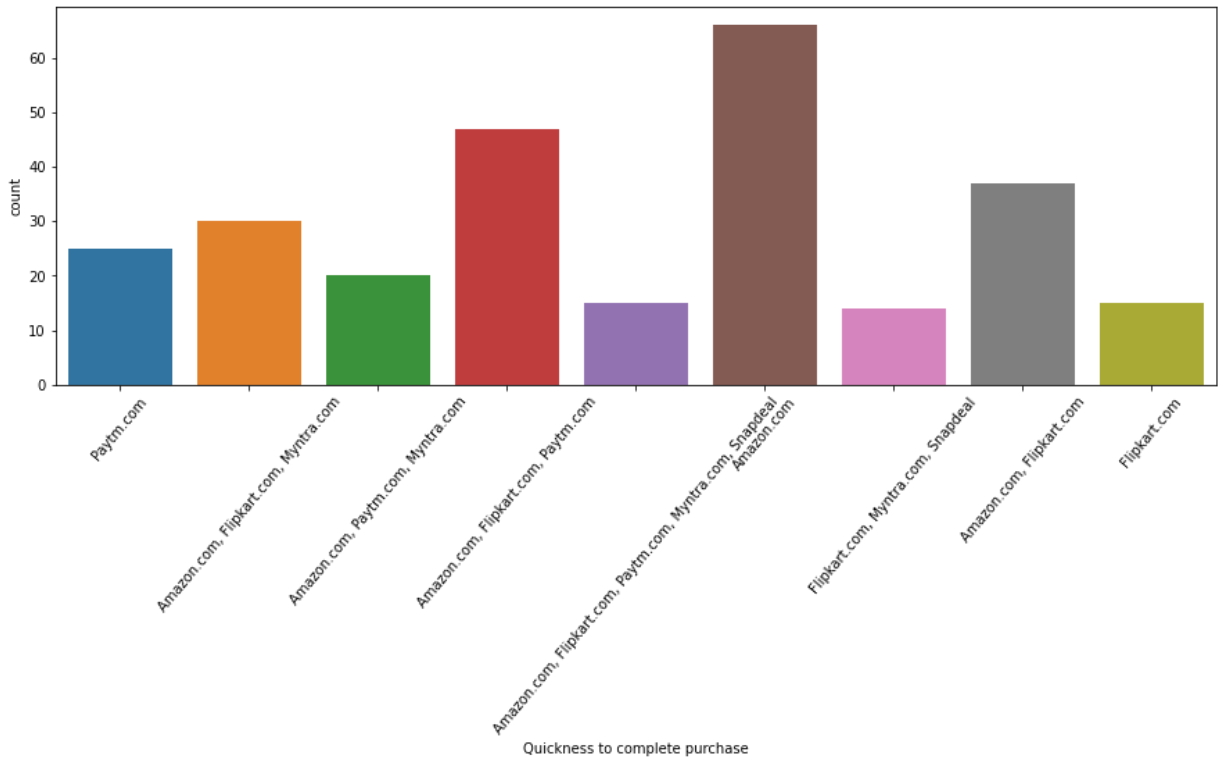
Out[53]:
```
<AxesSubplot:xlabel='Fast loading website speed of website and application', ylabel='count'>
```



In [54]:
```
plt.figure(figsize=(15,5))
plt.xticks(rotation=50)
print(df['Quickness to complete purchase'].value_counts())
sns.countplot(df['Quickness to complete purchase'])
```

```
Amazon.com                                                  66
Amazon.com, Flipkart.com, Paytm.com                         47
Amazon.com, Flipkart.com                                    37
Amazon.com, Flipkart.com, Myntra.com                        30
Paytm.com                                                   25
Amazon.com, Paytm.com, Myntra.com                           20
Flipkart.com                                                15
Amazon.com, Flipkart.com, Paytm.com, Myntra.com, Snapdeal   15
Flipkart.com, Myntra.com, Snapdeal                          14
Name: Quickness to complete purchase, dtype: int64
```

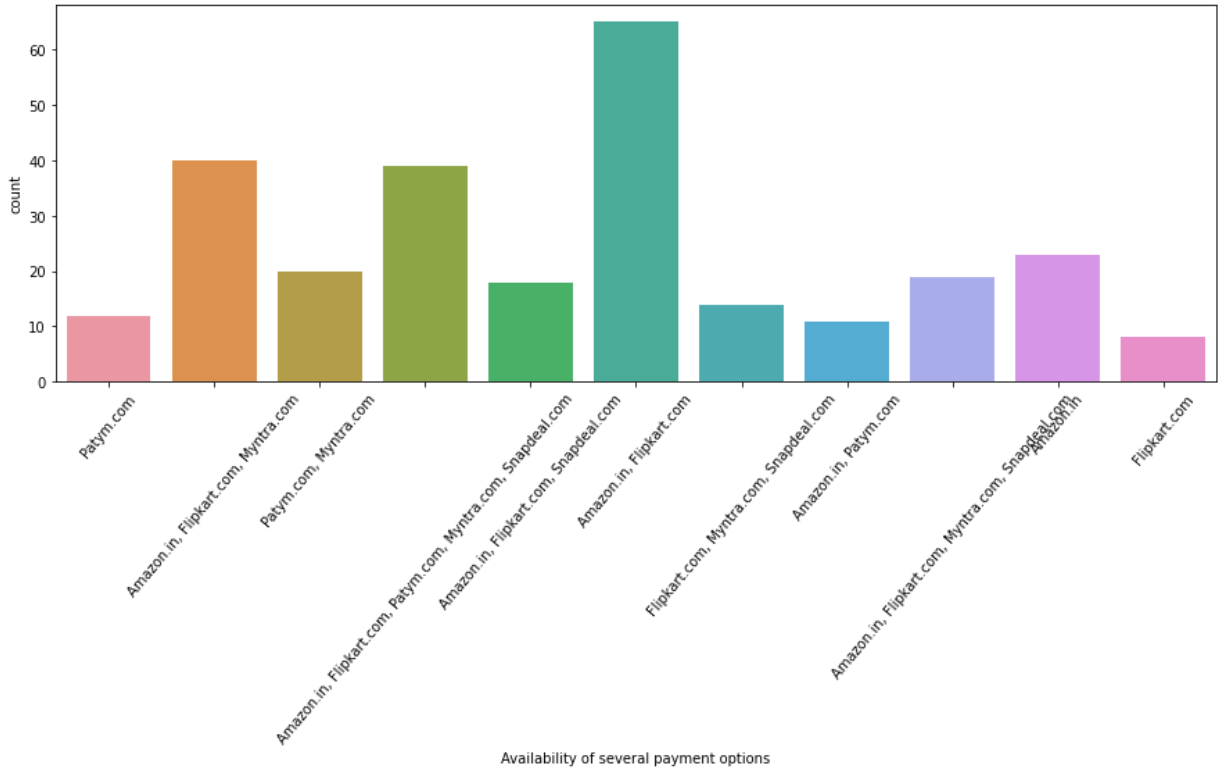
Out[54]: <AxesSubplot:xlabel='Quickness to complete purchase', ylabel='count'>



In [55]:
```
plt.figure(figsize=(15,5))
plt.xticks(rotation=50)
print(df['Availability of several payment options'].value_counts())
sns.countplot(df['Availability of several payment options'])
```

```
Amazon.in, Flipkart.com                                          65
Amazon.in, Flipkart.com, Myntra.com                              40
Amazon.in, Flipkart.com, Patym.com, Myntra.com, Snapdeal.com     39
Amazon.in                                                        23
Patym.com, Myntra.com                                            20
Amazon.in, Flipkart.com, Myntra.com, Snapdeal.com                19
Amazon.in, Flipkart.com, Snapdeal.com                            18
Flipkart.com, Myntra.com, Snapdeal.com                           14
Patym.com                                                        12
Amazon.in, Patym.com                                             11
Flipkart.com                                                      8
Name: Availability of several payment options, dtype: int64
```

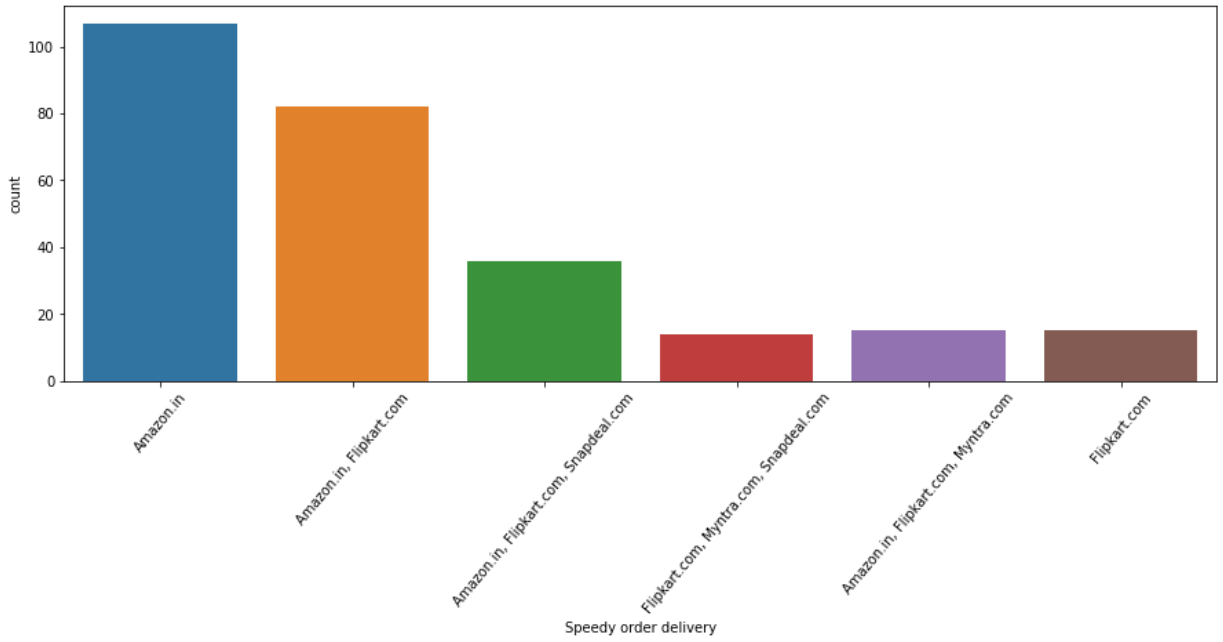
Out[55]:
```
<AxesSubplot:xlabel='Availability of several payment options', ylabel='count'>
```



In [56]:
```
plt.figure(figsize=(15,5))
plt.xticks(rotation=50)
print(df['Speedy order delivery'].value_counts())
sns.countplot(df['Speedy order delivery'])
```

```
Amazon.in                                  107
Amazon.in, Flipkart.com                     82
Amazon.in, Flipkart.com, Snapdeal.com       36
Amazon.in, Flipkart.com, Myntra.com         15
Flipkart.com                                15
Flipkart.com, Myntra.com, Snapdeal.com      14
Name: Speedy order delivery, dtype: int64
```

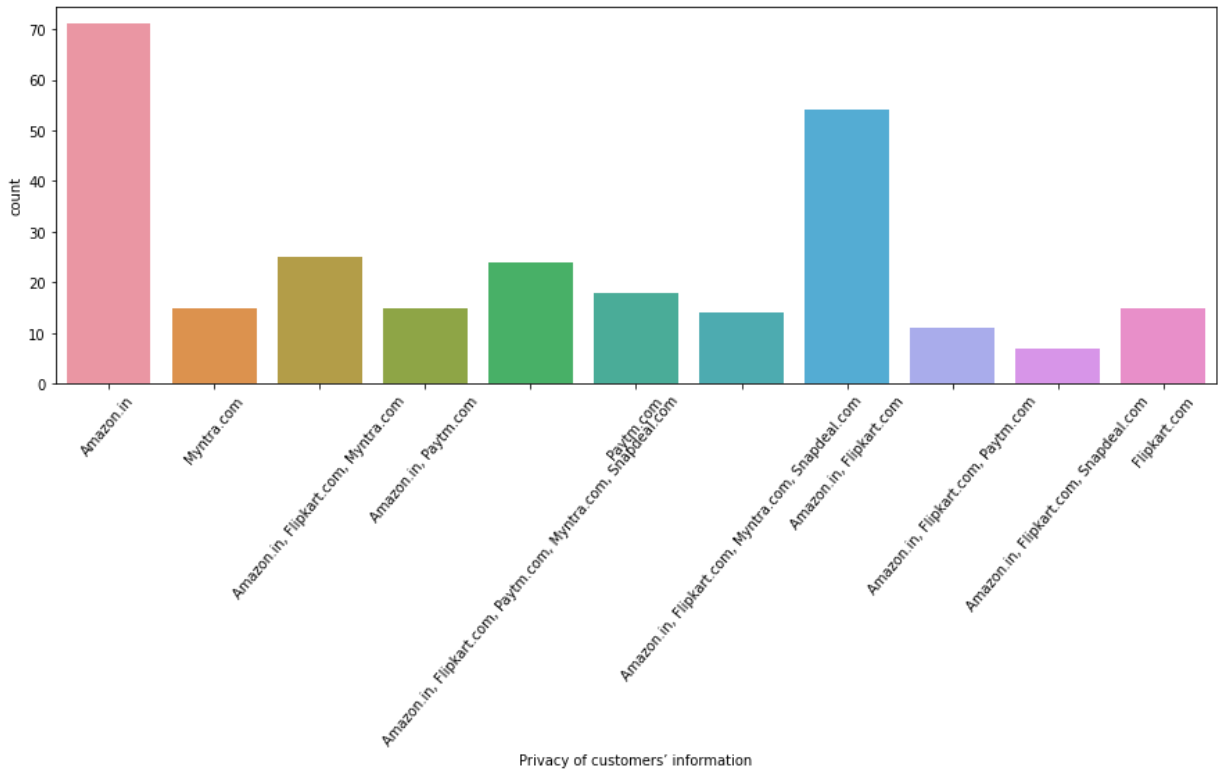
Out[56]: <AxesSubplot:xlabel='Speedy order delivery', ylabel='count'>



In [57]:
```
plt.figure(figsize=(15,5))
plt.xticks(rotation=50)
print(df['Privacy of customers' information'].value_counts())
sns.countplot(df['Privacy of customers' information'])
```

```
Amazon.in                                                    71
Amazon.in, Flipkart.com                                      54
Amazon.in, Flipkart.com, Myntra.com                          25
Amazon.in, Flipkart.com, Paytm.com, Myntra.com, Snapdeal.com 24
Paytm.com                                                    18
Amazon.in, Paytm.com                                         15
Myntra.com                                                   15
Flipkart.com                                                 15
Amazon.in, Flipkart.com, Myntra.com, Snapdeal.com            14
Amazon.in, Flipkart.com, Paytm.com                           11
Amazon.in, Flipkart.com, Snapdeal.com                         7
Name: Privacy of customers' information, dtype: int64
```

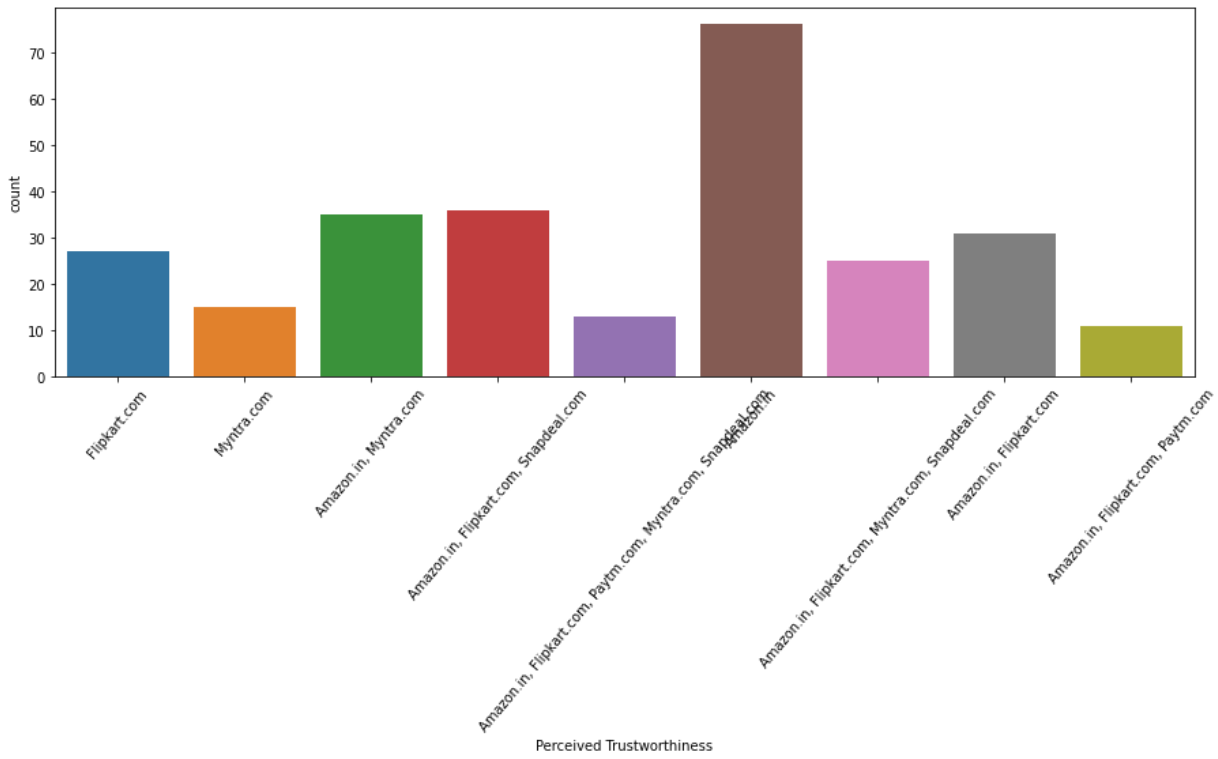
Out[57]: <AxesSubplot:xlabel='Privacy of customers' information', ylabel='count'>



In [58]:
```
plt.figure(figsize=(15,5))
plt.xticks(rotation=50)
print(df['Perceived Trustworthiness'].value_counts())
sns.countplot(df['Perceived Trustworthiness'])
```

```
Amazon.in                                                          76
Amazon.in, Flipkart.com, Snapdeal.com                              36
Amazon.in, Myntra.com                                              35
Amazon.in, Flipkart.com                                            31
Flipkart.com                                                       27
Amazon.in, Flipkart.com, Myntra.com, Snapdeal.com                  25
Myntra.com                                                         15
Amazon.in, Flipkart.com, Paytm.com, Myntra.com, Snapdeal.com       13
Amazon.in, Flipkart.com, Paytm.com                                 11
Name: Perceived Trustworthiness, dtype: int64
```

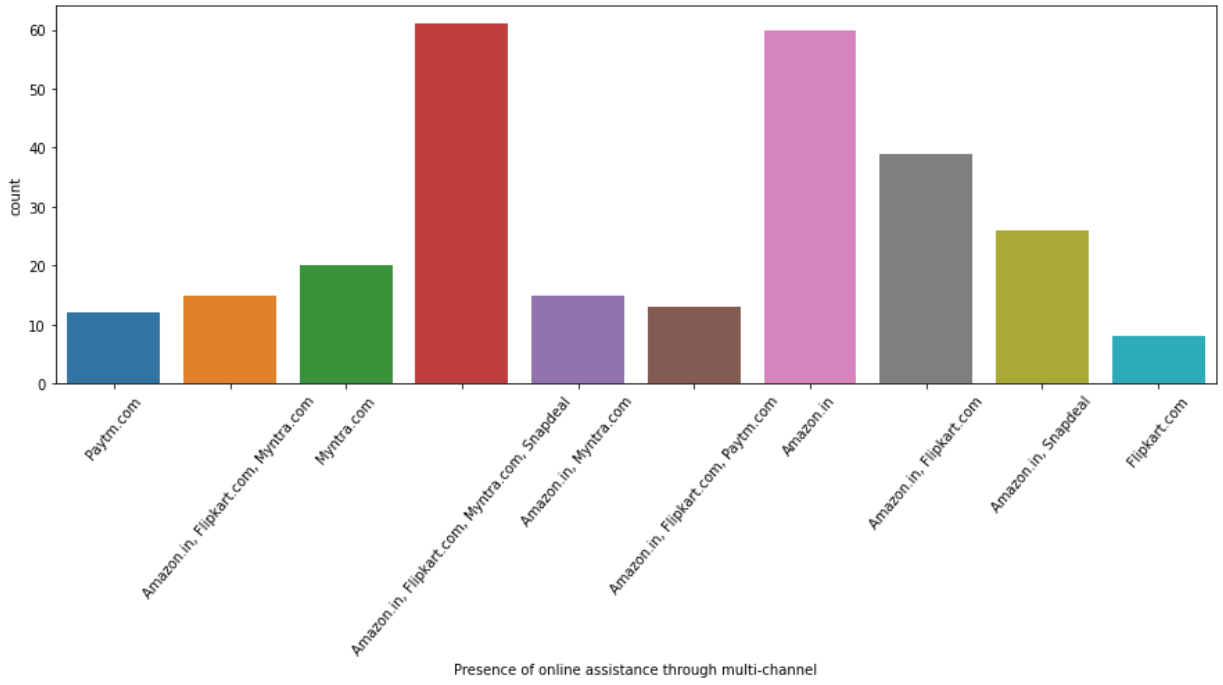
Out[58]: <AxesSubplot:xlabel='Perceived Trustworthiness', ylabel='count'>



In [59]:
```
plt.figure(figsize=(15,5))
plt.xticks(rotation=50)
print(df['Presence of online assistance through multi-channel'].value_counts())
sns.countplot(df['Presence of online assistance through multi-channel'])
```

```
Amazon.in, Flipkart.com, Myntra.com, Snapdeal    61
Amazon.in                                        60
Amazon.in, Flipkart.com                          39
Amazon.in, Snapdeal                              26
Myntra.com                                       20
Amazon.in, Myntra.com                            15
Amazon.in, Flipkart.com, Myntra.com              15
Amazon.in, Flipkart.com, Paytm.com               13
Paytm.com                                        12
Flipkart.com                                      8
Name: Presence of online assistance through multi-channel, dtype: int64
```

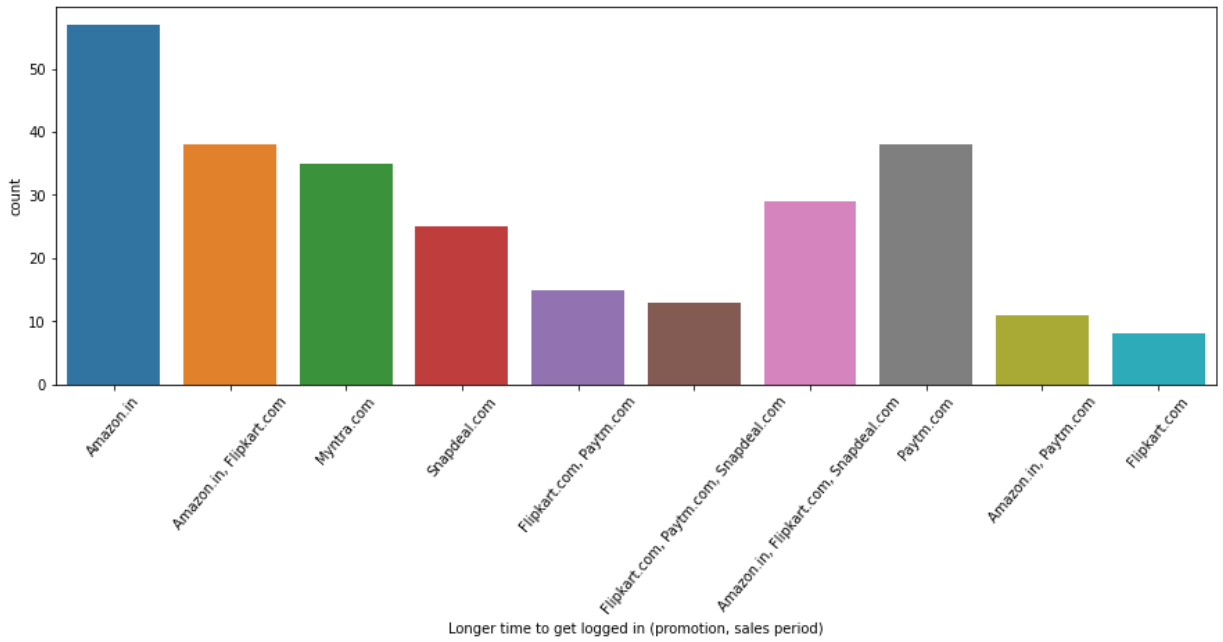
Out[59]:
```
<AxesSubplot:xlabel='Presence of online assistance through multi-channel', ylabel='count'>
```



In [60]:
```
plt.figure(figsize=(15,5))
plt.xticks(rotation=50)
print(df['Longer time to get logged in (promotion, sales period)'].value_counts()
sns.countplot(df['Longer time to get logged in (promotion, sales period)'])
```

```
Amazon.in                                57
Paytm.com                                38
Amazon.in, Flipkart.com                  38
Myntra.com                               35
Amazon.in, Flipkart.com, Snapdeal.com    29
Snapdeal.com                             25
Flipkart.com, Paytm.com                  15
Flipkart.com, Paytm.com, Snapdeal.com    13
Amazon.in, Paytm.com                     11
Flipkart.com                              8
Name: Longer time to get logged in (promotion, sales period), dtype: int64
```

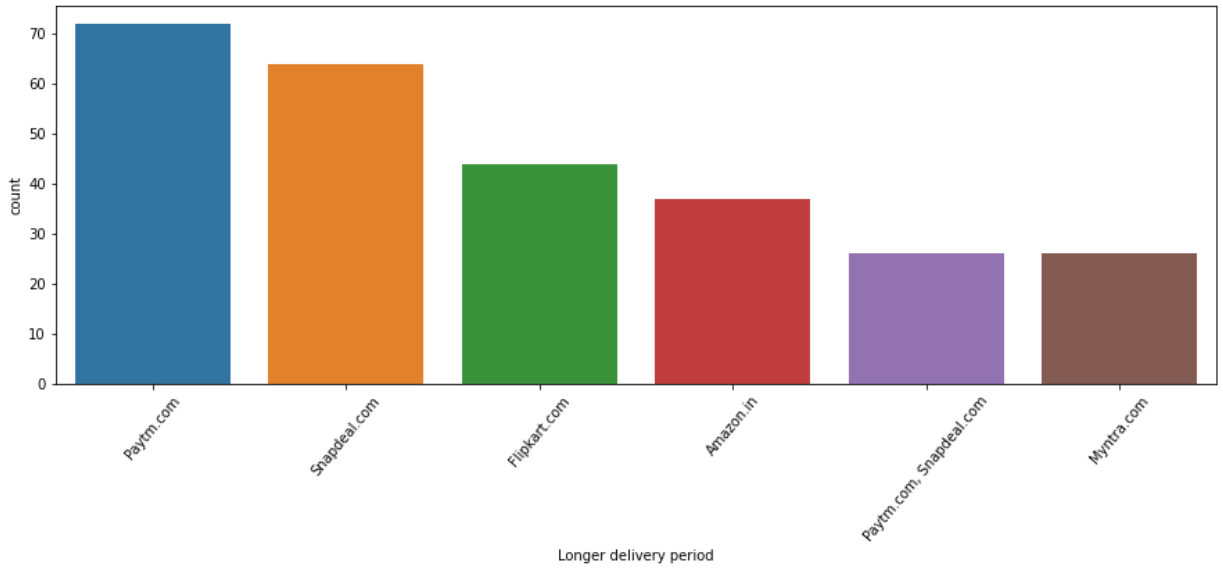
Out[60]:
```
<AxesSubplot:xlabel='Longer time to get logged in (promotion, sales period)', y
label='count'>
```



In [61]:
```
plt.figure(figsize=(15,5))
plt.xticks(rotation=50)
print(df['Longer delivery period'].value_counts())
sns.countplot(df['Longer delivery period'])
```

```
Paytm.com                  72
Snapdeal.com               64
Flipkart.com               44
Amazon.in                  37
Myntra.com                 26
Paytm.com, Snapdeal.com    26
Name: Longer delivery period, dtype: int64
```

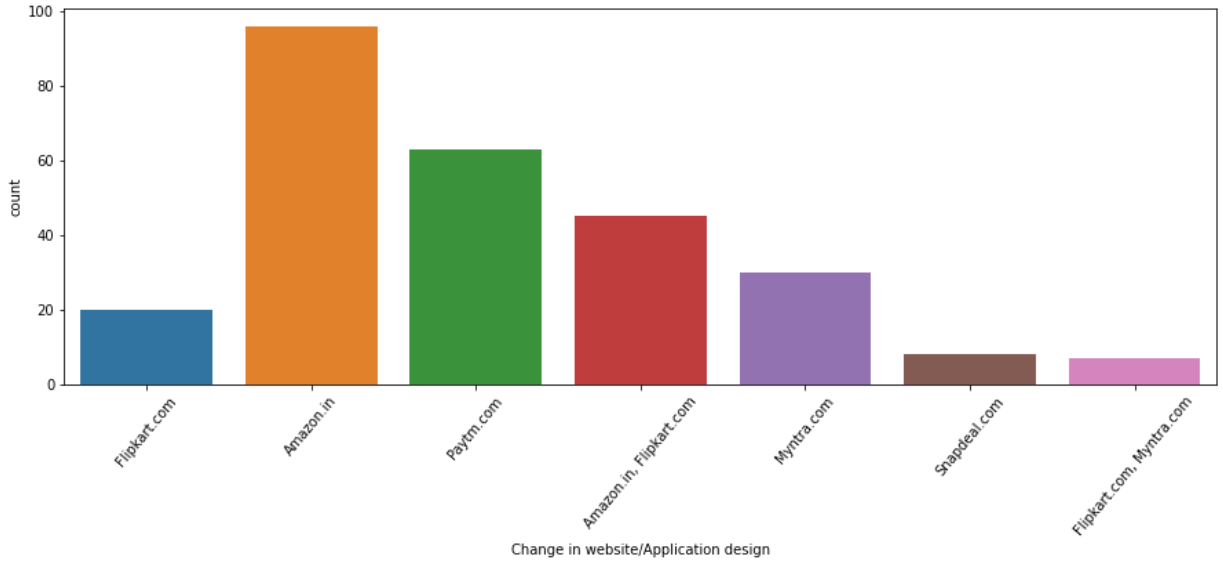
Out[61]: <AxesSubplot:xlabel='Longer delivery period', ylabel='count'>



In [62]:
```
plt.figure(figsize=(15,5))
plt.xticks(rotation=50)
print(df['Change in website/Application design'].value_counts())
sns.countplot(df['Change in website/Application design'])
```

```
Amazon.in                    96
Paytm.com                    63
Amazon.in, Flipkart.com      45
Myntra.com                   30
Flipkart.com                 20
Snapdeal.com                  8
Flipkart.com, Myntra.com      7
Name: Change in website/Application design, dtype: int64
```

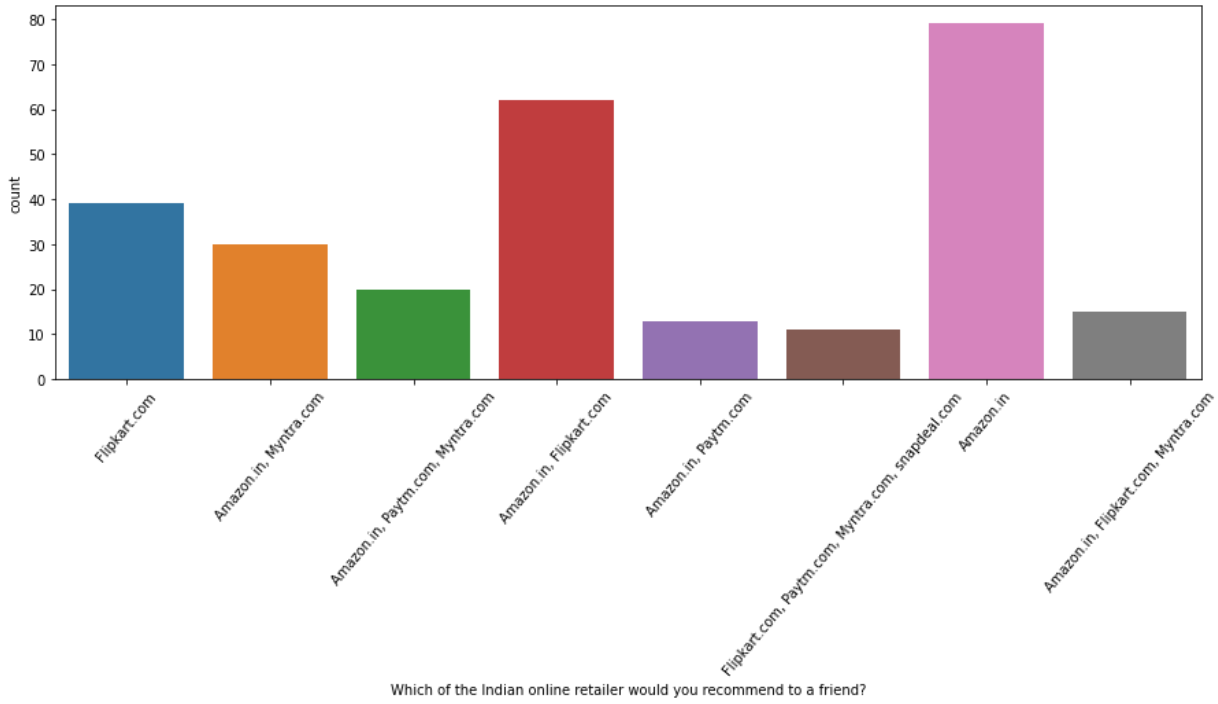
Out[62]: <AxesSubplot:xlabel='Change in website/Application design', ylabel='count'>



In [63]:
```
plt.figure(figsize=(15,5))
plt.xticks(rotation=50)
print(df['Which of the Indian online retailer would you recommend to a friend?'].
sns.countplot(df['Which of the Indian online retailer would you recommend to a fr
```

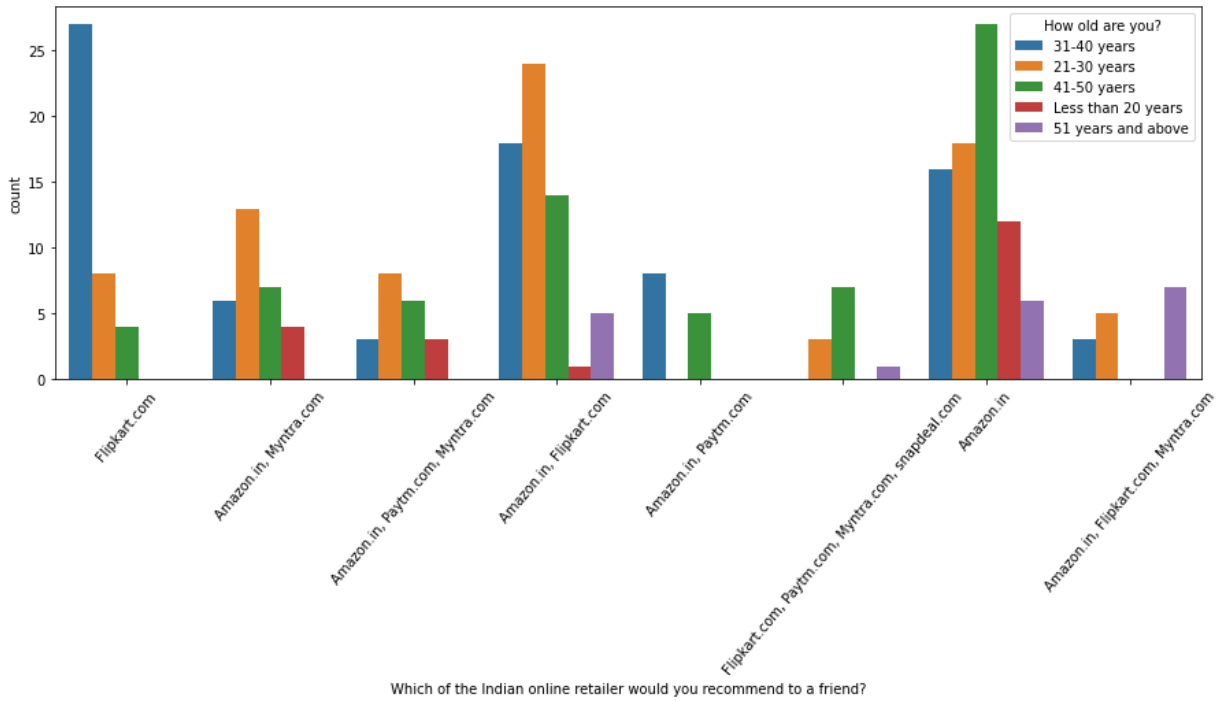
```
Amazon.in                                                  79
Amazon.in, Flipkart.com                                    62
Flipkart.com                                               39
Amazon.in, Myntra.com                                      30
Amazon.in, Paytm.com, Myntra.com                           20
Amazon.in, Flipkart.com, Myntra.com                        15
Amazon.in, Paytm.com                                       13
Flipkart.com, Paytm.com, Myntra.com, snapdeal.com          11
Name: Which of the Indian online retailer would you recommend to a friend?, dty
pe: int64
```

Out[63]:
```
<AxesSubplot:xlabel='Which of the Indian online retailer would you recommend to
a friend?', ylabel='count'>
```



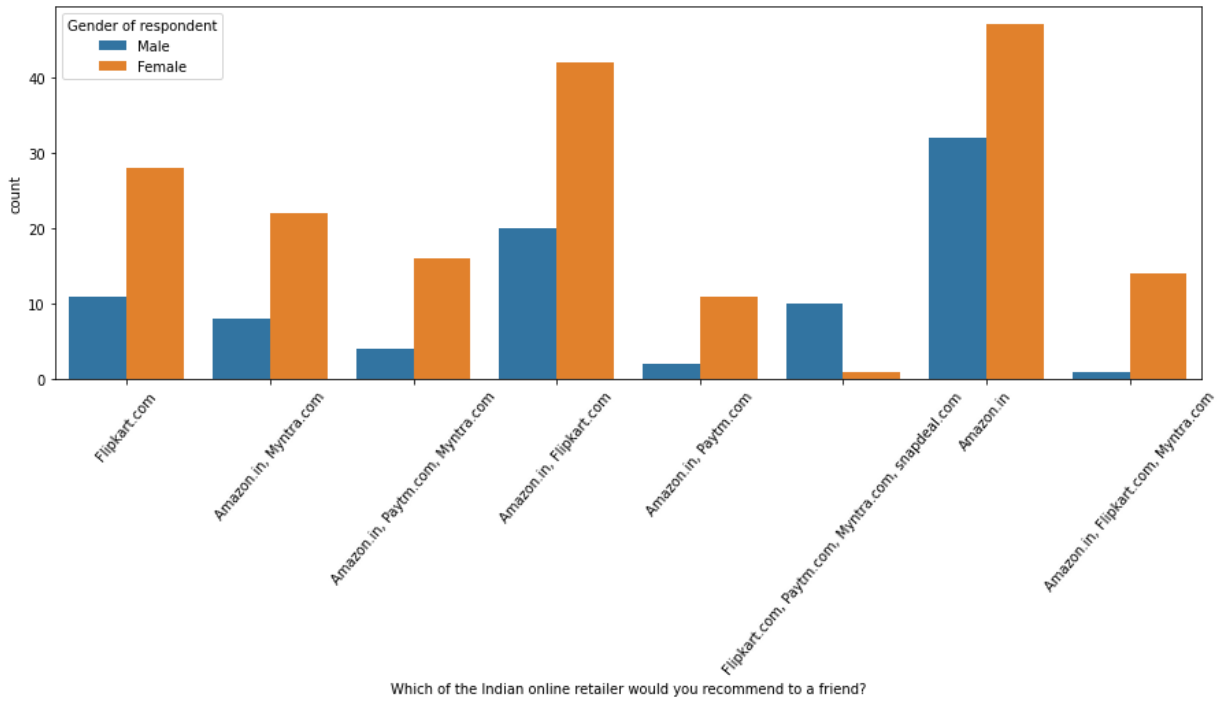
In [64]:
```
plt.figure(figsize=(15,5),facecolor='white')
plt.xticks(rotation=50)
sns.countplot(df['Which of the Indian online retailer would you recommend to a fr
```

Out[64]:
```
<AxesSubplot:xlabel='Which of the Indian online retailer would you recommend to
a friend?', ylabel='count'>
```



In [65]:
```
plt.figure(figsize=(15,5),facecolor='white')
plt.xticks(rotation=50)
sns.countplot(df['Which of the Indian online retailer would you recommend to a fr
```

Out[65]:
```
<AxesSubplot:xlabel='Which of the Indian online retailer would you recommend to
a friend?', ylabel='count'>
```



In [ ]:

In [ ]:

In [66]:
```
LE=LabelEncoder()
for i in df.columns:
    if df[i].dtypes=="object":
        df[i]=LE.fit_transform(df[i])
```

In [67]:
```
# Checking the dataframe after encoding
df.head()
```

Out[67]:

	Gender of respondent	How old are you?	Which city do you shop online from?	What is the Pin Code of where you shop online from?	Since How Long You are Shopping Online ?	How many times you have made an online purchase in the past year?	How do you access the internet while shopping on-line?	Which device do you use to access the online shopping?	What is the screen size of your mobile device?	What tl operatir syste (OS) yo device
0	1	1	2	110009	3	2	0	0	3	
1	0	0	2	110030	3	3	3	2	0	
2	0	0	4	201308	2	3	1	2	2	
3	1	0	6	132001	2	5	1	2	2	
4	0	0	0	530068	1	0	3	2	0	

5 rows × 71 columns

In [68]:
```
# Checking statistical summary of the dataset
df.describe()
```

Out[68]:

	Gender of respondent	How old are you?	Which city do you shop online from?	What is the Pin Code of where you shop online from?	Since How Long You are Shopping Online ?	How many times you have made an online purchase in the past year?	How do you access the internet while shopping on-line?
count	269.000000	269.000000	269.000000	269.000000	269.000000	269.000000	269.000000
mean	0.327138	1.330855	4.494424	220465.747212	2.323420	3.237918	2.078067
std	0.470042	1.183774	3.187687	140524.341051	1.176357	1.739331	0.715919
min	0.000000	0.000000	0.000000	110008.000000	0.000000	0.000000	0.000000
25%	0.000000	0.000000	2.000000	122018.000000	1.000000	2.000000	2.000000
50%	0.000000	1.000000	4.000000	201303.000000	3.000000	3.000000	2.000000
75%	1.000000	2.000000	7.000000	201310.000000	3.000000	5.000000	3.000000
max	1.000000	4.000000	10.000000	560037.000000	4.000000	5.000000	3.000000

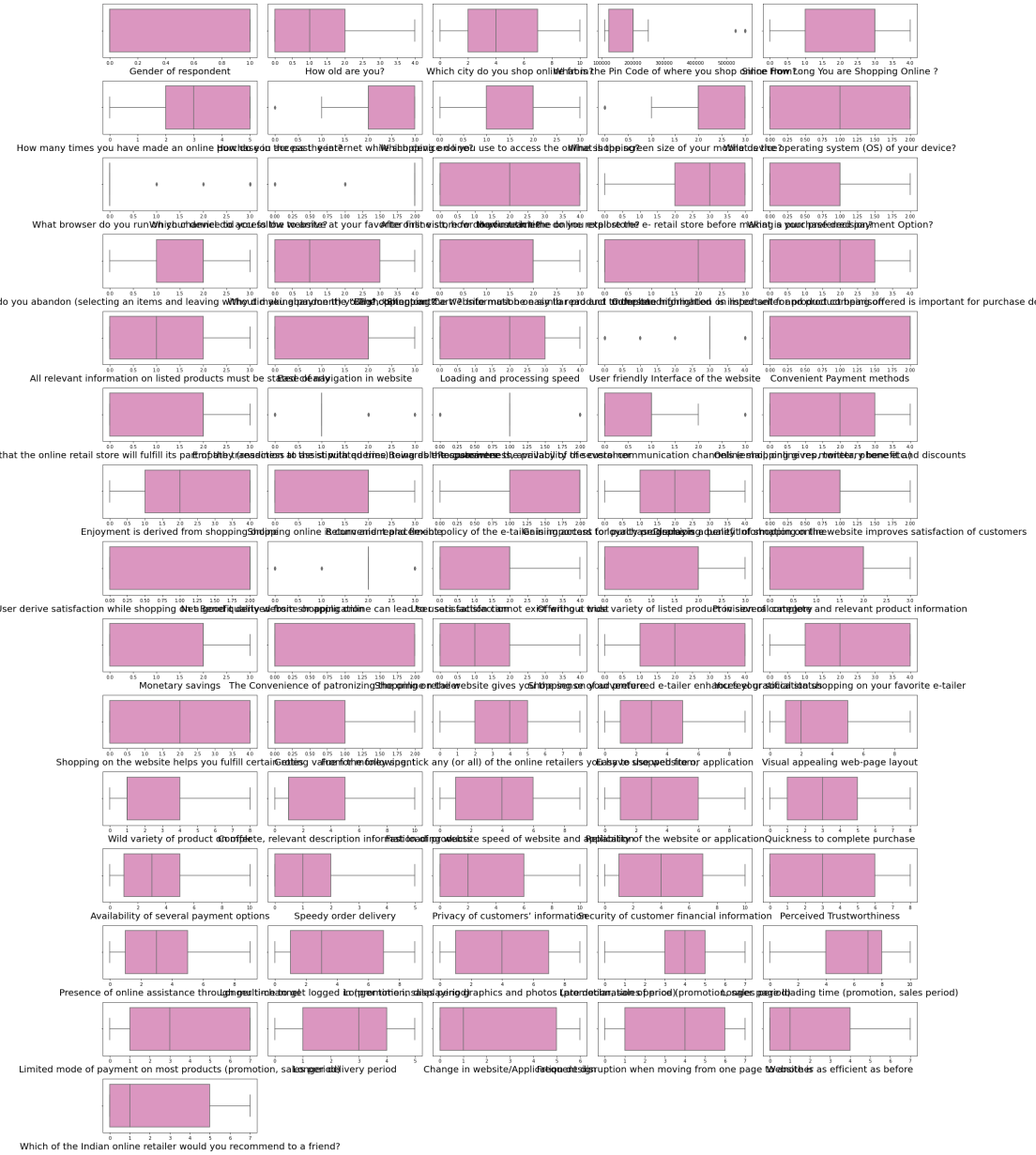
8 rows × 71 columns

Before we got only one column's statistical summary, after label encoding we can able to notice all the columns statistical summary.

- Here the count of all the columns are same which means there are no missing values present in the dataset.
- Some of the columns have their mean value greater than the median (50%), so we can say they are skewed to right.
- In some of the columns, the median is greater than the mean, so the data is skewed to left.
- We can also notice the min value, standard deviation and 25% percentile.
- In summarising the data, we cna notice huge difference between max and 75% percentile in some of the columns which means there are huge outliers present in those columns.
- Since all the columns in the dataset are categorical, no need to remove outliers and skewness.

In [69]:
```
# Let's check the outliers by ploting box plot

plt.figure(figsize=(25,35),facecolor='white')
plotnumber=1
for column in df:
    if plotnumber<=71:
        ax=plt.subplot(15,5,plotnumber)
        sns.boxplot(df[column],palette="Set2_r")
        plt.xlabel(column,fontsize=20)
    plotnumber+=1
plt.tight_layout()
```



In [70]:
```
# Checking the skewness
df.skew()
```

Out[70]:
```
Gender of respondent                                                0.741
028
How old are you?                                                    0.680
987
Which city do you shop online from?                                 0.313
729
What is the Pin Code of where you shop online from?                 1.748
322
Since How Long You are Shopping Online ?                           -0.276
968
                                                                     ...
Longer delivery period                                             -0.147
702
Change in website/Application design                                0.354
163
Frequent disruption when moving from one page to another           -0.100
608
Website is as efficient as before                                   0.662
084
Which of the Indian online retailer would you recommend to a friend?    0.583
614
Length: 71, dtype: float64
```

- The outliers present in many of the columns but the dataset contains all the categorical data so no need to remove the outliers.
- Skewness is also present in many of the columns but all the columns are categorical so no need to remove skewness also.

In [71]:
```
# Checking the correlation between features and the target
cor = df.corr()
cor
```

Out[71]:

	Gender of respondent	How old are you?	Which city do you shop online from?	What is the Pin Code of where you shop online from?	Since How Long You are Shopping Online ?	How many times you have made an online purchase in the past year?	How do you access the internet while shopping on-line?	y a s
Gender of respondent	1.000000	0.046169	0.080912	-0.260365	-0.057096	0.077876	-0.309029	
How old are you?	0.046169	1.000000	0.113712	-0.120704	-0.087847	0.309575	0.255594	
Which city do you shop online from?	0.080912	0.113712	1.000000	-0.416597	-0.138329	0.173871	-0.010436	
What is the Pin Code of where you shop online from?	-0.260365	-0.120704	-0.416597	1.000000	-0.090049	-0.263685	0.005511	
Since How Long You are Shopping Online ?	-0.057096	-0.087847	-0.138329	-0.090049	1.000000	0.013315	0.226883	
...	...	...	...	...	...	...	...	
Longer delivery period	0.060838	-0.156173	-0.123369	-0.078660	0.218641	-0.130651	0.101297	
Change in website/Application design	-0.164818	-0.134558	0.000427	-0.058715	0.220347	0.007841	0.147770	
Frequent disruption when moving from one page to another	-0.256638	-0.018825	0.019167	0.039936	0.025919	-0.127148	0.349813	
Website is as efficient as before	0.055663	-0.008582	0.007117	0.037662	-0.024316	-0.124076	0.266932	
Which of the Indian online retailer would you recommend to a friend?	-0.003372	-0.135263	-0.142123	-0.045388	0.136106	-0.152028	0.041129	

71 rows × 71 columns

For building a machine learning model we will having 'Which of the Indian online retailer would you recommend to a friend?' as our target variable

In [72]:
```
# Splitting Data into target and Input
x=df.drop(['Which of the Indian online retailer would you recommend to a friend?'
y=df['Which of the Indian online retailer would you recommend to a friend?']
```

In [73]:
```
x.head()
```

Out[73]:

	Gender of respondent	How old are you?	Which city do you shop online from?	What is the Pin Code of where you shop online from?	Since How Long You are Shopping Online ?	How many times you have made an online purchase in the past year?	How do you access the internet while shopping on-line?	Which device do you use to access the online shopping?	What is the screen size of your mobile device?	What tl operatir syste (OS) yo device
0	1	1	2	110009	3	2	0	0	3	
1	0	0	2	110030	3	3	3	2	0	
2	0	0	4	201308	2	3	1	2	2	
3	1	0	6	132001	2	5	1	2	2	
4	0	0	0	530068	1	0	3	2	0	

5 rows × 70 columns

In [74]:
```
y.head()
```

Out[74]:
```
0    6
1    3
2    5
3    1
4    3
Name: Which of the Indian online retailer would you recommend to a friend?, dty
pe: int32
```

In [75]:
```
x.shape, y.shape
```

Out[75]:
```
((269, 70), (269,))
```

Applying Standard scaler to independent variables

In [76]:
```
scale=StandardScaler() # Standard scaler instance
x=scale.fit_transform(x) # applied to independent variables
```

Decision Tree is Configured for 200 Random State

In [77]:
```
for i in range(200):
    x_train, x_test, y_train, y_test = train_test_split(x,y, test_size=0.33, rand
    lm = DecisionTreeClassifier()
    lm.fit(x_train,y_train)
    pred=lm.predict(x_test)
    accu=accuracy_score(y_test,pred)
    print(accu*100, "at random_state", i)
```

```
98.87640449438202 at random_state 0
100.0 at random_state 1
100.0 at random_state 2
100.0 at random_state 3
100.0 at random_state 4
97.75280898876404 at random_state 5
98.87640449438202 at random_state 6
100.0 at random_state 7
100.0 at random_state 8
98.87640449438202 at random_state 9
100.0 at random_state 10
98.87640449438202 at random_state 11
98.87640449438202 at random_state 12
100.0 at random_state 13
100.0 at random_state 14
100.0 at random_state 15
100.0 at random_state 16
98.87640449438202 at random_state 17
98.87640449438202 at random_state 18
```

In [78]:
```
maxAccu=0
maxRS=0
for i in range(1,200):
    x_train, x_test, y_train, y_test = train_test_split(x,y,test_size=0.30, randc
    mod = DecisionTreeClassifier()
    mod.fit(x_train, y_train)
    pred = mod.predict(x_test)
    acc=accuracy_score(y_test, pred)
    if acc>maxAccu:
        maxAccu=acc
        maxRS=i
print("Best accuracy is ", maxAccu," on Random_state ",maxRS)
```

```
Best accuracy is  1.0  on Random_state  4
```

Splitting Training Set & Test Set.

In [79]:
```
x_train, x_test, y_train, y_test = train_test_split(x,y,test_size=0.30, random_st
```

In [80]:
```
# Applying Logistic Regression on train and test data
lg=LogisticRegression()
lg.fit(x_train,y_train)
pred=lg.predict(x_test)
print(pred)
print(accuracy_score(y_test,pred))
acc = classification_report(y_test, pred)
print(acc)
```

```
[1 0 1 2 1 1 7 0 0 3 5 7 0 1 1 6 6 6 1 0 0 2 1 3 0 5 0 0 0 7 2 6 1 2 0 6 1
 0 0 0 1 3 1 1 3 1 4 0 2 5 3 1 1 5 0 1 0 5 5 1 1 3 0 6 7 2 6 3 1 7 1 6 3 6
 2 1 3 4 6 0 1]
1.0
              precision    recall  f1-score   support

           0       1.00      1.00      1.00        19
           1       1.00      1.00      1.00        23
           2       1.00      1.00      1.00         7
           3       1.00      1.00      1.00         9
           4       1.00      1.00      1.00         2
           5       1.00      1.00      1.00         6
           6       1.00      1.00      1.00        10
           7       1.00      1.00      1.00         5

    accuracy                           1.00        81
   macro avg       1.00      1.00      1.00        81
weighted avg       1.00      1.00      1.00        81
```

In [81]:
```
# Applying Decision Tree Classifier on train and test data
DTC = DecisionTreeClassifier()
DTC.fit(x_train, y_train)
pred = DTC.predict(x_test)
print(accuracy_score(y_test,pred))
acc = classification_report(y_test, pred)
print(acc)
```

```
1.0
              precision    recall  f1-score   support

           0       1.00      1.00      1.00        19
           1       1.00      1.00      1.00        23
           2       1.00      1.00      1.00         7
           3       1.00      1.00      1.00         9
           4       1.00      1.00      1.00         2
           5       1.00      1.00      1.00         6
           6       1.00      1.00      1.00        10
           7       1.00      1.00      1.00         5

    accuracy                           1.00        81
   macro avg       1.00      1.00      1.00        81
weighted avg       1.00      1.00      1.00        81
```

In [82]:
```
# Applying Random Forest Classifier on train and test data
RFC = RandomForestClassifier()
RFC.fit(x_train, y_train)
pred = RFC.predict(x_test)
print(accuracy_score(y_test,pred))
acc = classification_report(y_test, pred)
print(acc)
```

```
1.0
              precision    recall  f1-score   support

           0       1.00      1.00      1.00        19
           1       1.00      1.00      1.00        23
           2       1.00      1.00      1.00         7
           3       1.00      1.00      1.00         9
           4       1.00      1.00      1.00         2
           5       1.00      1.00      1.00         6
           6       1.00      1.00      1.00        10
           7       1.00      1.00      1.00         5

    accuracy                           1.00        81
   macro avg       1.00      1.00      1.00        81
weighted avg       1.00      1.00      1.00        81
```

In [83]:
```
# Applying Support Vector Classifier on train and test data
SV = SVC()
SV.fit(x_train, y_train)
pred = SV.predict(x_test)
print(accuracy_score(y_test,pred))
acc = classification_report(y_test, pred)
print(acc)
```

```
1.0
              precision    recall  f1-score   support

           0       1.00      1.00      1.00        19
           1       1.00      1.00      1.00        23
           2       1.00      1.00      1.00         7
           3       1.00      1.00      1.00         9
           4       1.00      1.00      1.00         2
           5       1.00      1.00      1.00         6
           6       1.00      1.00      1.00        10
           7       1.00      1.00      1.00         5

    accuracy                           1.00        81
   macro avg       1.00      1.00      1.00        81
weighted avg       1.00      1.00      1.00        81
```

In [84]:
```
# Applying KNN Classifier on train and test data
knn=KNeighborsClassifier(n_neighbors=5)
knn.fit(x_train,y_train)
pred=knn.predict(x_test)
print(accuracy_score(y_test,pred))
acc = classification_report(y_test, pred)
print(acc)
```

```
1.0
              precision    recall  f1-score   support

           0       1.00      1.00      1.00        19
           1       1.00      1.00      1.00        23
           2       1.00      1.00      1.00         7
           3       1.00      1.00      1.00         9
           4       1.00      1.00      1.00         2
           5       1.00      1.00      1.00         6
           6       1.00      1.00      1.00        10
           7       1.00      1.00      1.00         5

    accuracy                           1.00        81
   macro avg       1.00      1.00      1.00        81
weighted avg       1.00      1.00      1.00        81
```

K-fold Cross Validation

In [85]:
```
# Creating CV Object with shuffle = true to avoid -ve CV Values as o/p
cross_validation=KFold(5, shuffle =True)
```

In [86]:
```
# Logistic regression
print(cross_val_score(lg,x,y,cv=cross_validation).mean())
```

```
1.0
```

In [87]:
```
# Decision Tree Classifier
print(cross_val_score(DTC,x,y,cv=cross_validation).mean())
```

```
0.9888888888888889
```

In [88]:
```
# Random Forest Classifier
print(cross_val_score(RFC,x,y,cv=cross_validation).mean())
```

```
1.0
```

In [89]:
```
# Support Vector Classifier
print(cross_val_score(SV,x,y,cv=cross_validation).mean())
```

```
1.0
```

In [90]:
```
#  KNN Classifier
print(cross_val_score(knn,x,y,cv=cross_validation).mean())
```

```
1.0
```

Best Model Selection

- lets use KNN as the best model.

Hyperparameter & GridsearchCV

In [91]:
```
parameter = {'n_neighbors' : [1,2,4,5],
             'weights':['uniform', 'distance'],
             'algorithm':['auto', 'ball_tree'],
             'leaf_size': [30],
             'metric':['minkowski']}
```

In [92]:
```
GCV=GridSearchCV(KNeighborsClassifier(),parameter,cv=cross_validation)
GCV.fit(x_train,y_train)
```

Out[92]:
```
GridSearchCV(cv=KFold(n_splits=5, random_state=None, shuffle=True),
             estimator=KNeighborsClassifier(),
             param_grid={'algorithm': ['auto', 'ball_tree'], 'leaf_size': [30],
                         'metric': ['minkowski'], 'n_neighbors': [1, 2, 4, 5],
                         'weights': ['uniform', 'distance']})
```

In [93]:
```
GCV.best_params_
```

Out[93]:
```
{'algorithm': 'auto',
 'leaf_size': 30,
 'metric': 'minkowski',
 'n_neighbors': 1,
 'weights': 'uniform'}
```

In [94]:
```
Final_mod = KNeighborsClassifier(algorithm = 'auto', leaf_size = 30,metric= 'mink
Final_mod.fit(x_train, y_train)
pred = Final_mod.predict(x_test)
acc=accuracy_score(y_test,pred)
print(acc*100)
```

```
100.0
```

Exporting Model with Joblib Library

In [95]:
```
# Model is exported as .pkl file with the help of joblib library.
import joblib
joblib.dump(Final_mod,"FinalModel.pkl")
```

Out[95]:
```
['FinalModel.pkl']
```

In [96]:
```
import numpy as np
a=np.array(y_test)
a
```

Out[96]:
```
array([1, 0, 1, 2, 1, 1, 7, 0, 0, 3, 5, 7, 0, 1, 1, 6, 6, 6, 1, 0, 0, 2,
       1, 3, 0, 5, 0, 0, 0, 7, 2, 6, 1, 2, 0, 6, 1, 0, 0, 0, 1, 3, 1, 1,
       3, 1, 4, 0, 2, 5, 3, 1, 1, 5, 0, 1, 0, 5, 5, 1, 1, 3, 0, 6, 7, 2,
       6, 3, 1, 7, 1, 6, 3, 6, 2, 1, 3, 4, 6, 0, 1])
```

In [97]:
```
predicted=np.array(knn.predict(x_test))
predicted
predicted.shape
knn.predict(x_test)
```

Out[97]:
```
array([1, 0, 1, 2, 1, 1, 7, 0, 0, 3, 5, 7, 0, 1, 1, 6, 6, 6, 1, 0, 0, 2,
       1, 3, 0, 5, 0, 0, 0, 7, 2, 6, 1, 2, 0, 6, 1, 0, 0, 0, 1, 3, 1, 1,
       3, 1, 4, 0, 2, 5, 3, 1, 1, 5, 0, 1, 0, 5, 5, 1, 1, 3, 0, 6, 7, 2,
       6, 3, 1, 7, 1, 6, 3, 6, 2, 1, 3, 4, 6, 0, 1])
```

In [98]:
```
conclusion=pd.DataFrame({"original":a,"predicted":predicted}, index= range(len(a)
conclusion
```

Out[98]:

	original	predicted
0	1	1
1	0	0
2	1	1
3	2	2
4	1	1
...	...	...
76	3	3
77	4	4
78	6	6
79	0	0
80	1	1

81 rows × 2 columns

In [ ]: