Project_Name - Health_Insurance_Cross_Sell_Prediction

Project_Type - Classification

Contrubution - Individual

Name - Ravikant Khandare

In [1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from scipy.stats import uniform
from scipy.stats import norm
from scipy.stats import chi2
from scipy.stats import t
from scipy.stats import f
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.model_selection import GridSearchCV
from imblearn.over_sampling import SMOTE
from sklearn.linear_model import LogisticRegression
from sklearn.tree import DecisionTreeClassifier
from sklearn.neighbors import KNeighborsClassifier
from sklearn.ensemble import RandomForestClassifier
from sklearn import metrics
from sklearn.metrics import accuracy_score
from sklearn.metrics import precision_score
from sklearn.metrics import recall_score
from sklearn.metrics import f1_score
from sklearn.metrics import roc_auc_score
from sklearn.metrics import roc_curve
from sklearn.metrics import classification_report
```

In [2]:
```
data=pd.read_csv(r"D:\FingerTip's\Panda's Class 1\TRAIN-HEALTH INSURANCE CROSS SELL
```

In [3]:
```
data.head()
```

Out[3]:

	id	Gender	Age	Driving_License	Region_Code	Previously_Insured	Vehicle_Age	Vehicl
0	1	Male	44	1	28.0	0	> 2 Years	
1	2	Male	76	1	3.0	0	1-2 Year	
2	3	Male	47	1	28.0	0	> 2 Years	
3	4	Male	21	1	11.0	1	< 1 Year	
4	5	Female	29	1	41.0	1	< 1 Year	

In [4]:
```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 381109 entries, 0 to 381108
Data columns (total 12 columns):
 #   Column                Non-Null Count   Dtype  
---  ------                --------------   -----  
 0   id                    381109 non-null  int64  
 1   Gender                381109 non-null  object 
 2   Age                   381109 non-null  int64  
 3   Driving_License       381109 non-null  int64  
 4   Region_Code           381109 non-null  float64
 5   Previously_Insured    381109 non-null  int64  
 6   Vehicle_Age           381109 non-null  object 
 7   Vehicle_Damage        381109 non-null  object 
 8   Annual_Premium        381109 non-null  float64
 9   Policy_Sales_Channel  381109 non-null  float64
 10  Vintage               381109 non-null  int64  
 11  Response              381109 non-null  int64  
dtypes: float64(3), int64(6), object(3)
memory usage: 34.9+ MB
```

In [5]:
```
data.describe()
```

Out[5]:

	id	Age	Driving_License	Region_Code	Previously_Insured	A
count	381109.000000	381109.000000	381109.000000	381109.000000	381109.000000	
mean	190555.000000	38.822584	0.997869	26.388807	0.458210	
std	110016.836208	15.511611	0.046110	13.229888	0.498251	
min	1.000000	20.000000	0.000000	0.000000	0.000000	
25%	95278.000000	25.000000	1.000000	15.000000	0.000000	
50%	190555.000000	36.000000	1.000000	28.000000	0.000000	
75%	285832.000000	49.000000	1.000000	35.000000	1.000000	
max	381109.000000	85.000000	1.000000	52.000000	1.000000	

In [6]:
```
data.shape
```

Out[6]:
```
(381109, 12)
```

In [7]:
```
# checking the sum of null value for each column
data.isna().sum()
```

Out[7]:
```
id                    0
Gender                0
Age                   0
Driving_License       0
Region_Code           0
Previously_Insured    0
Vehicle_Age           0
Vehicle_Damage        0
Annual_Premium        0
Policy_Sales_Channel  0
Vintage               0
Response              0
dtype: int64
```

In [8]:
```
data.columns
```

Out[8]:
```
Index(['id', 'Gender', 'Age', 'Driving_License', 'Region_Code',
       'Previously_Insured', 'Vehicle_Age', 'Vehicle_Damage', 'Annual_Premium',
       'Policy_Sales_Channel', 'Vintage', 'Response'],
      dtype='object')
```

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

Out[9]:
```
id                    381109
Gender                     2
Age                       66
Driving_License            2
Region_Code               53
Previously_Insured         2
Vehicle_Age                3
Vehicle_Damage             2
Annual_Premium         48838
Policy_Sales_Channel     155
Vintage                  290
Response                   2
dtype: int64
```

In [10]:
```
a=data
```

In [11]:
```
a.head(5)
```

Out[11]:

	id	Gender	Age	Driving_License	Region_Code	Previously_Insured	Vehicle_Age	Vehicl
0	1	Male	44	1	28.0	0	> 2 Years	
1	2	Male	76	1	3.0	0	1-2 Year	
2	3	Male	47	1	28.0	0	> 2 Years	
3	4	Male	21	1	11.0	1	< 1 Year	
4	5	Female	29	1	41.0	1	< 1 Year	

In [12]:
```
a["Driving_License"]=a["Driving_License"].apply(lambda x: "Yes" if x==1 else "No")
a["Previously_Insured"]=a["Previously_Insured"].apply(lambda x: "Yes" if x==1 else
```

In [13]:
```
# To change data type float to int
a["Region_Code"]=a.Region_Code.astype(int)
a["Annual_Premium"]=a.Annual_Premium.astype(int)
a["Policy_Sales_Channel"]=a.Policy_Sales_Channel.astype(int)
```

In [14]:
```
# divide data in categorical nad numerical features
numeric_feature=a.select_dtypes(exclude="object")
categorical_feature=a.select_dtypes(include="object")
```

In [15]:
```
numeric_feature.head()
```

Out[15]:

	id	Age	Region_Code	Annual_Premium	Policy_Sales_Channel	Vintage	Response
0	1	44	28	40454	26	217	1
1	2	76	3	33536	26	183	0
2	3	47	28	38294	26	27	1
3	4	21	11	28619	152	203	0
4	5	29	41	27496	152	39	0

In [16]:
```
categorical_feature.head()
```

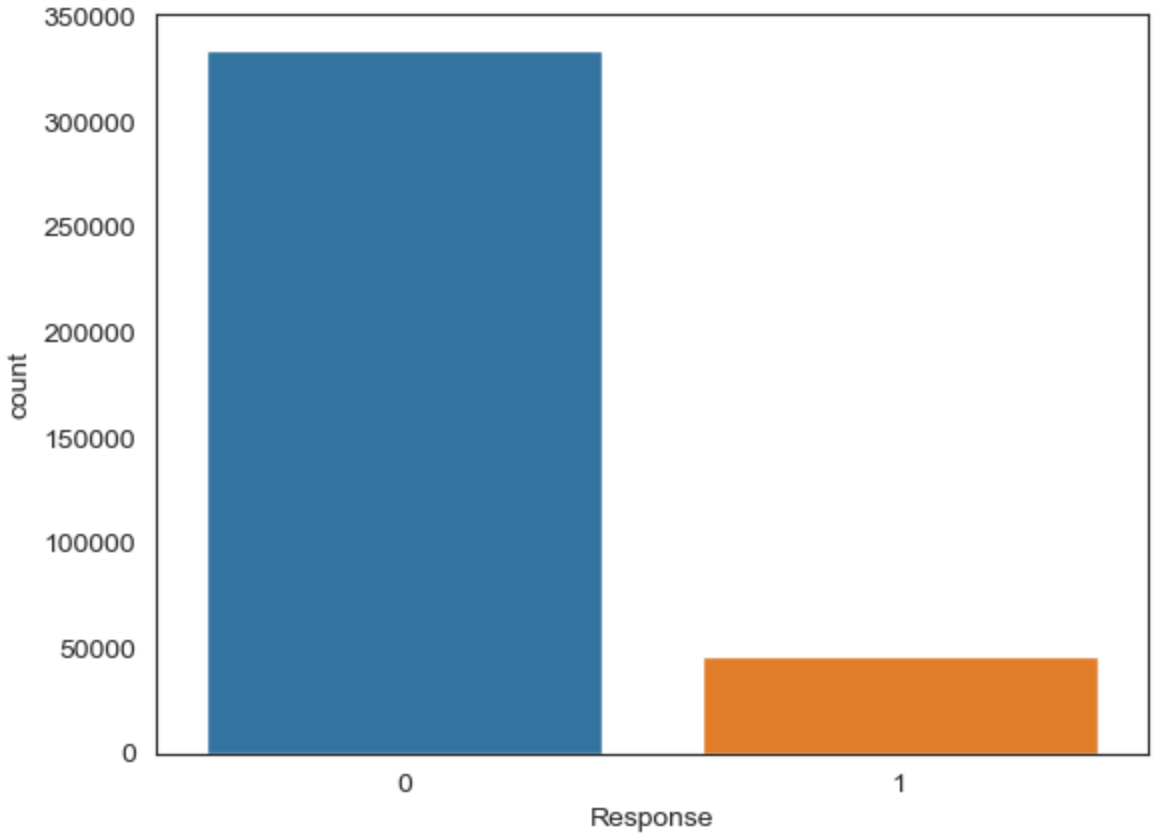
Out[16]:

	Gender	Driving_License	Previously_Insured	Vehicle_Age	Vehicle_Damage
0	Male	Yes	No	> 2 Years	Yes
1	Male	Yes	No	1-2 Year	No
2	Male	Yes	No	> 2 Years	Yes
3	Male	Yes	Yes	< 1 Year	No
4	Female	Yes	Yes	< 1 Year	No

In [17]:
```
sns.set_style(style=("white"))
```

In [18]:
```
sns.countplot(x=data["Response"],data=data)
```

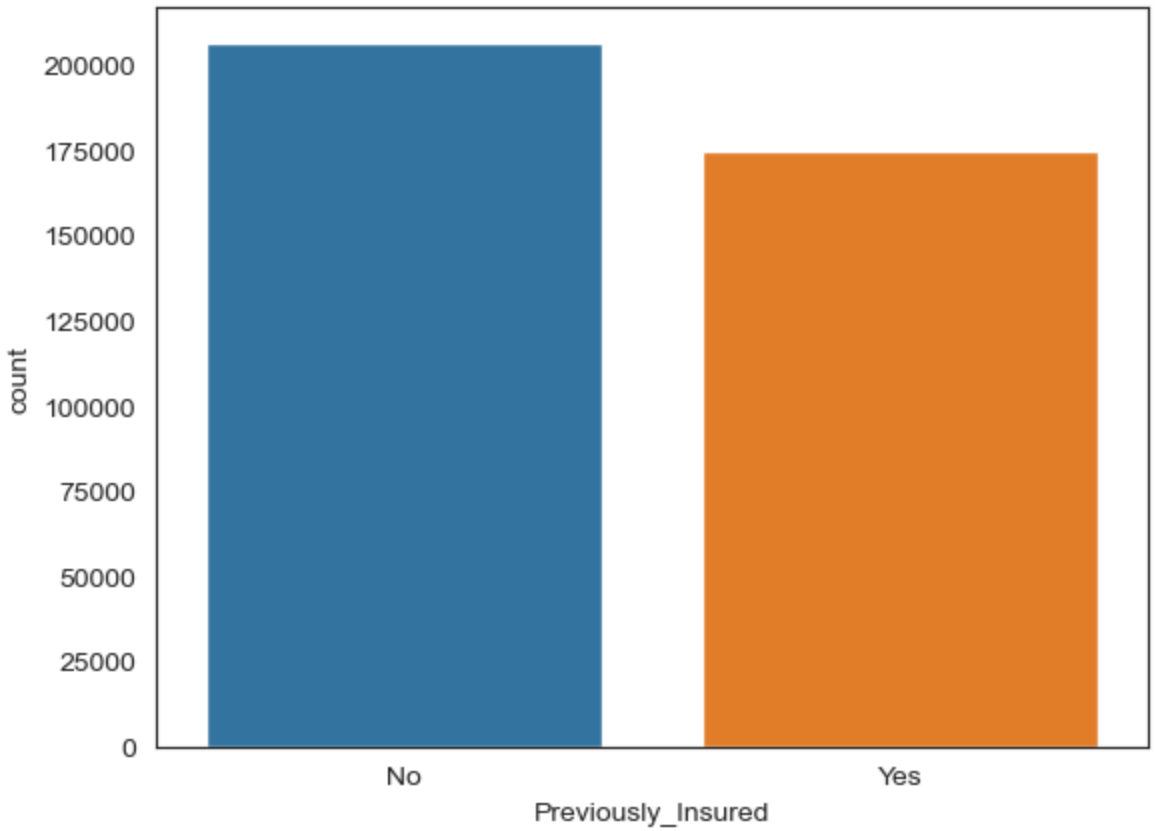
Out[18]: <Axes: xlabel='Response', ylabel='count'>



In [19]:
```
# count plot one is the best way to vusualize the value count distribution of a cat

# out of the total respondent i.e.3.81.109 poeple only 12.25% of (46.710) peoplew e
 #vehical insurence from our company

# Are they any insides that lead to negative growth? justify the specific reason

#  the gained inside sheds light on the crossselling conversion rate of the company
 # 12% the company can improve the conversion rate by taking steps to encorage peop
    #insurance by offring some incentive / ease of application and claim settelment
    #might be an effective way to increase the profit since the customer aqqusition
```

In [20]:
```
sns.countplot(x=data["Previously_Insured"],data=data)
```

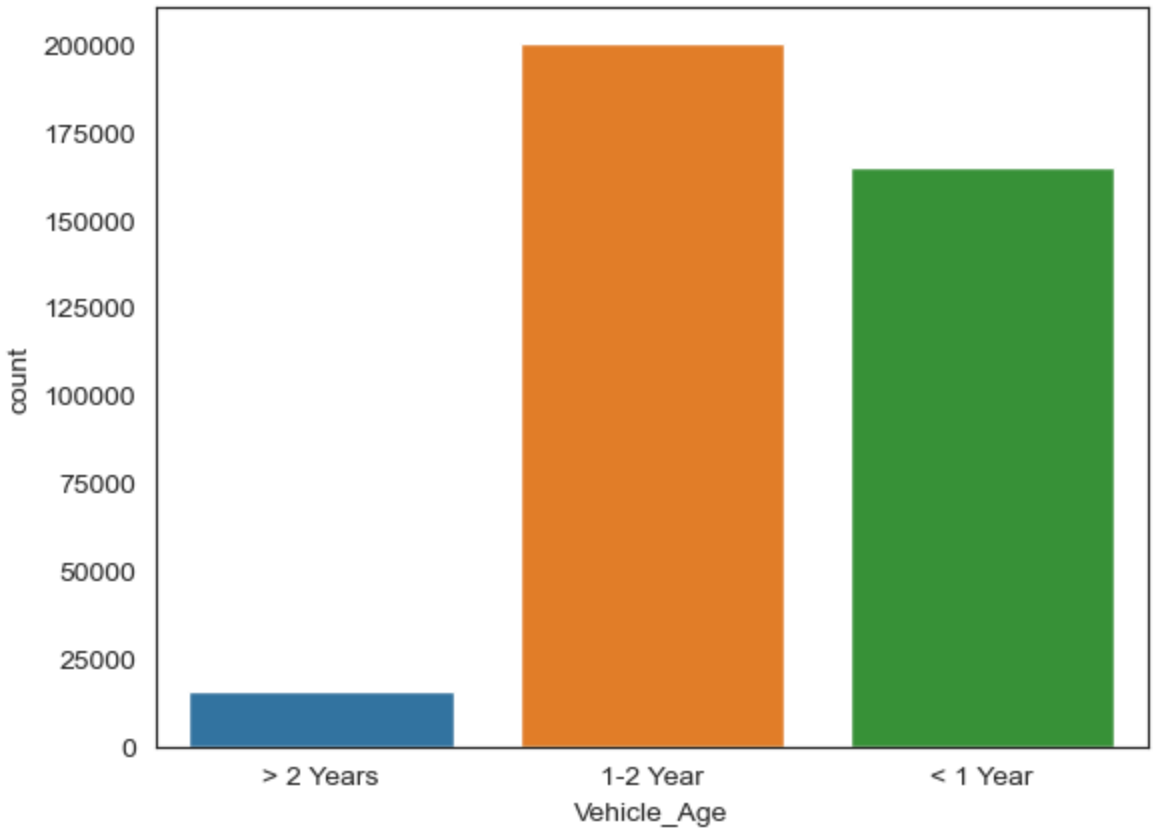
Out[20]: <Axes: xlabel='Previously_Insured', ylabel='count'>



In [21]:
```
# Out of total respodent i.e.3,81,109 people 54% (2,06,481) pleople had no previous

# are they any inside that lead to negative growth? justyfi with specific reason

# As the mejority of the people had no previous vehical insurence, the company gets
# thus creating a positive business impact
```

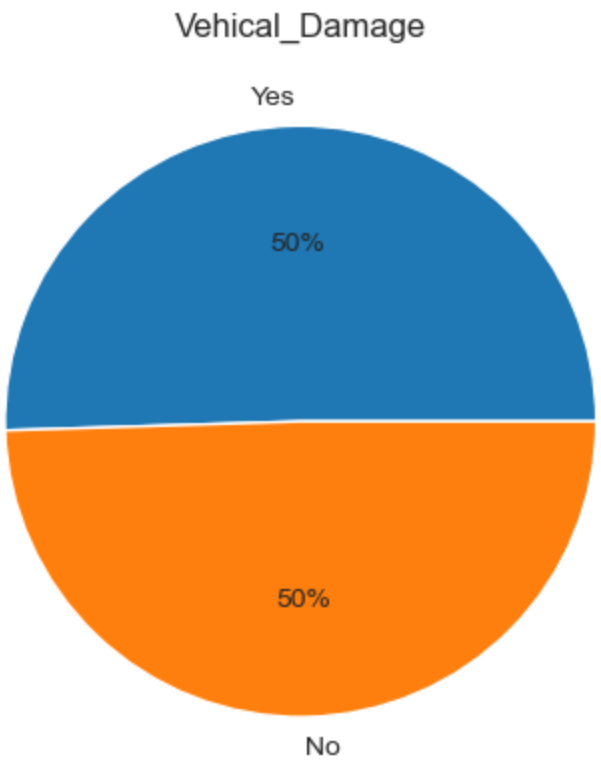
In [22]:
```
sns.countplot(x=data["Vehicle_Age"],data=data)
```

Out[22]:
```
<Axes: xlabel='Vehicle_Age', ylabel='count'>
```



In [23]:
```
# count plot is the one of the best way to visualize the value count distribution o

# The mejority of the vehical processed by the customer if in age range < 1 year or

# Are there any inside that lead to negative prowth ? justify with specific reason
 # This can have  a possitive impact because, as most of them are young vehical, th
    # the premium rate for newer vehicals are lower thus making it many it more lik
```

In [24]:
```
plt.pie(data["Vehicle_Damage"].value_counts(),labels=data["Vehicle_Damage"].value_c
plt.title("Vehical_Damage")
plt.show()
```

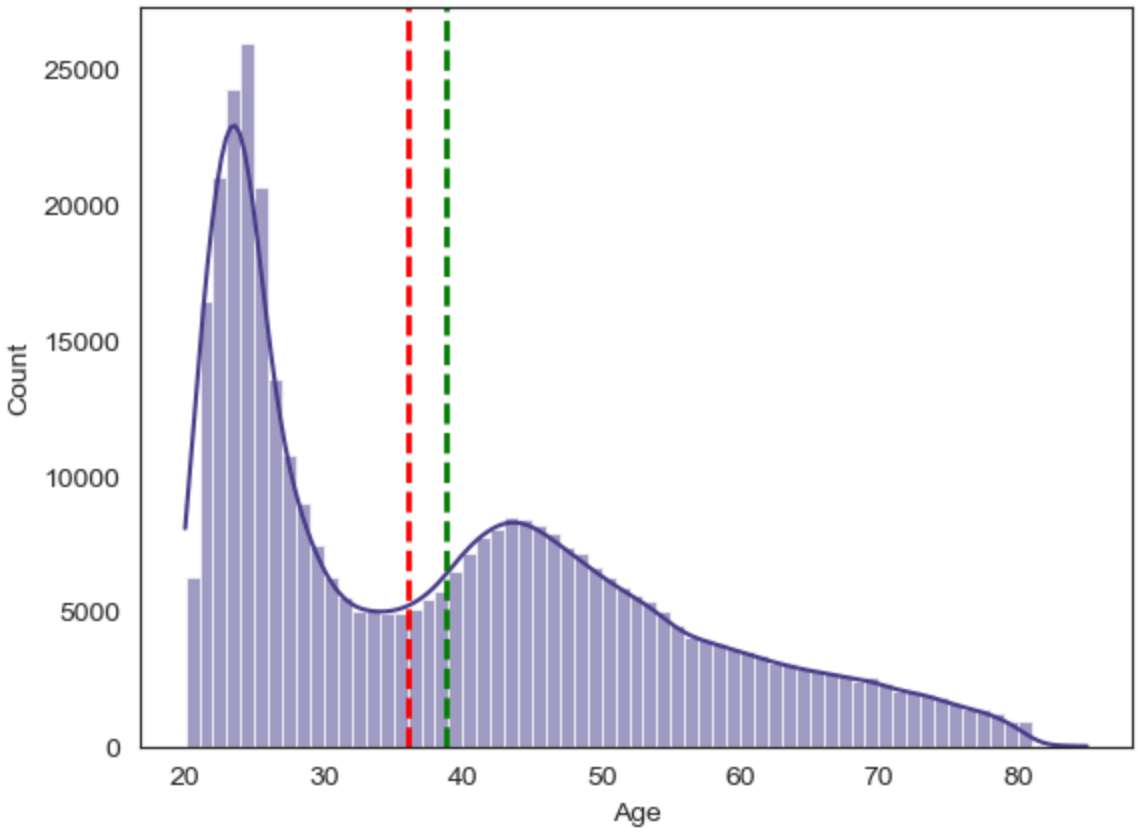


In [25]:
```
# Half the helth insurence customers have previously damage vehical

# Are there any inside that lead to negative prowth ? justify with specific reason

# this might lead to negative business impact because 40-50% claimrate in vehical i
# industries can have huge financial impact on the company,
```

In [26]:
```
sns.histplot(data["Age"],kde=True,color="darkslateblue",bins=np.arange(data["Age"].
plt.axvline(data["Age"].mean(),color="g",linestyle="dashed",linewidth=2)
plt.axvline(data["Age"].median(),color="red",linestyle="dashed",linewidth=2)
```

```
C:\ProgramData\anaconda3\Lib\site-packages\seaborn\_oldcore.py:1119: FutureWarning:
use_inf_as_na option is deprecated and will be removed in a future version. Convert
inf values to NaN before operating instead.
  with pd.option_context('mode.use_inf_as_na', True):
```

Out[26]:
```
<matplotlib.lines.Line2D at 0x1c7adecbc10>
```

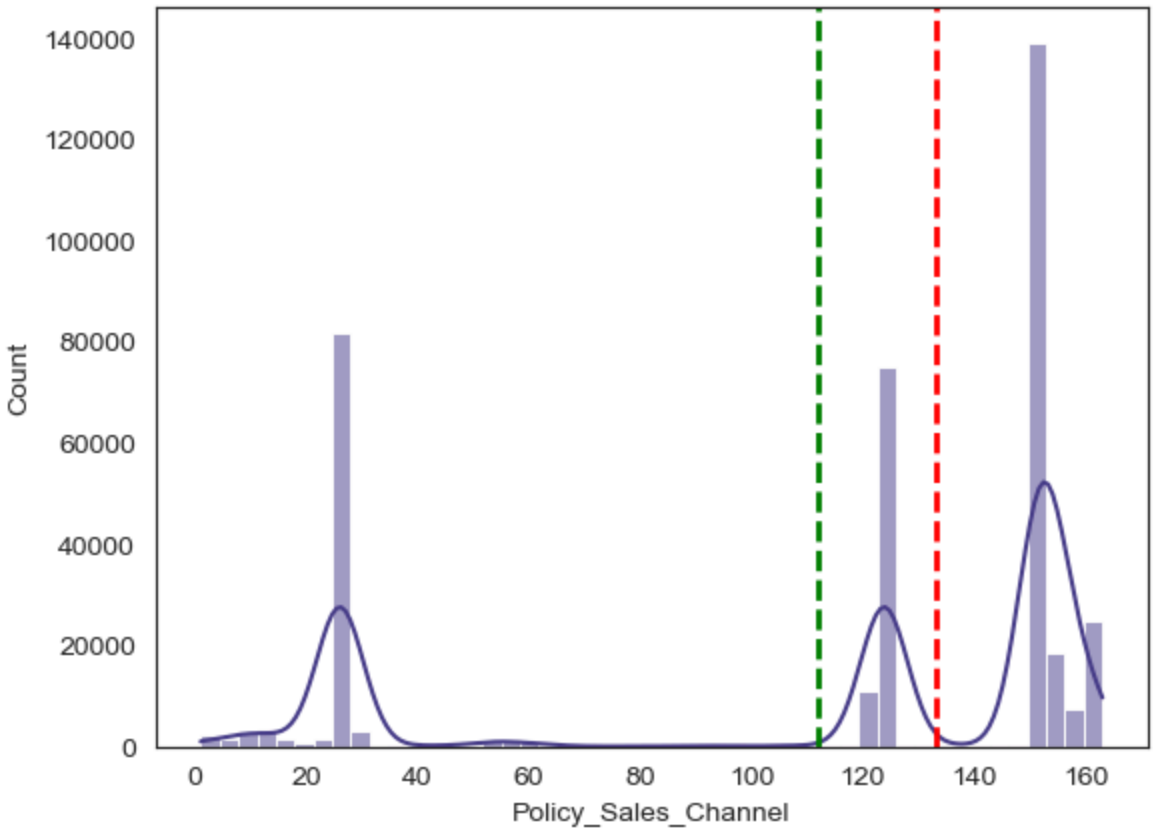


In [27]:
```
# histogram along with the KDE line lets us visualize and the distributin of the fu
```

In [28]:
```
sns.histplot(x=data["Policy_Sales_Channel"],kde=True,color="darkslateblue")
plt.axvline(data["Policy_Sales_Channel"].mean(),color="g",linestyle="dashed",linewi
plt.axvline(data["Policy_Sales_Channel"].median(),color="red",linestyle="dashed",li
```

```
C:\ProgramData\anaconda3\Lib\site-packages\seaborn\_oldcore.py:1119: FutureWarning:
use_inf_as_na option is deprecated and will be removed in a future version. Convert
inf values to NaN before operating instead.
  with pd.option_context('mode.use_inf_as_na', True):
```

Out[28]:
```
<matplotlib.lines.Line2D at 0x1c7ae5f3c10>
```

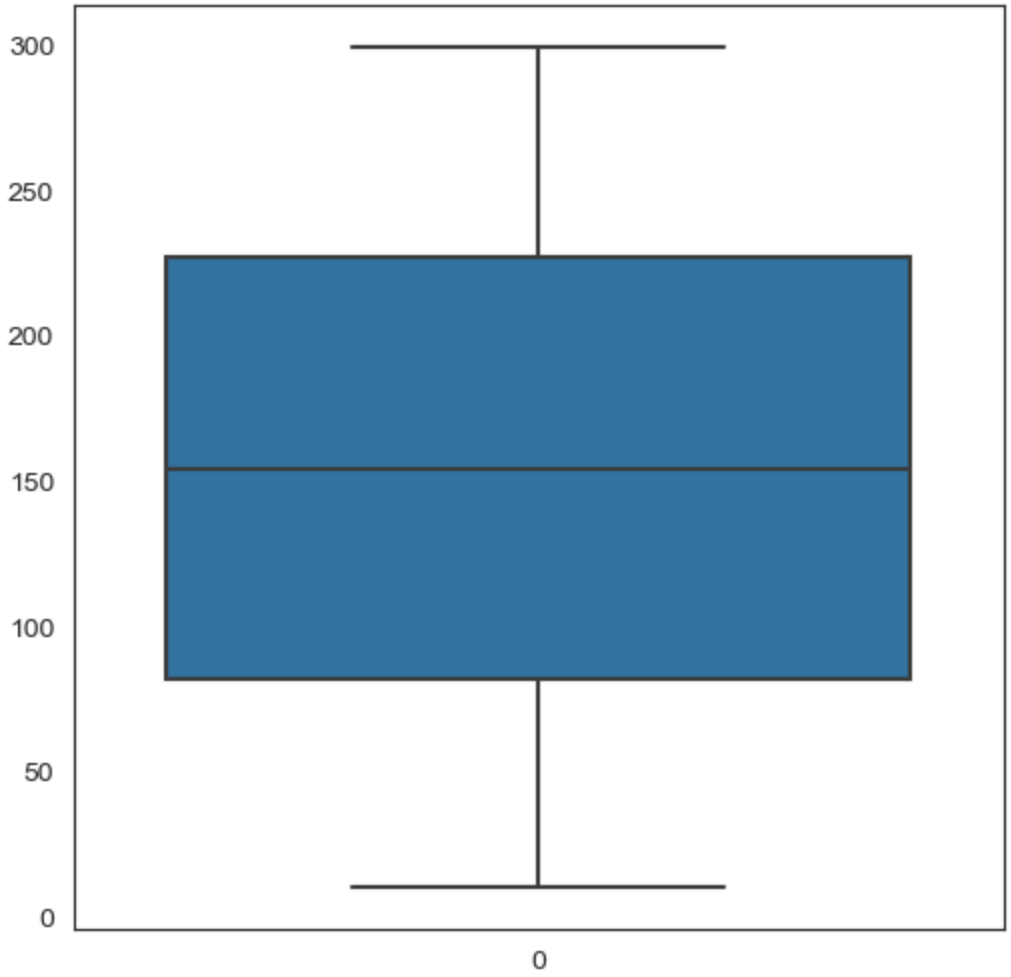


In [29]:
```
data["Policy_Sales_Channel"].value_counts().head(20)
```

Out[29]:
```
Policy_Sales_Channel
152    134784
26      79700
124     73995
160     21779
156     10661
122      9930
157      6684
154      5993
151      3885
163      2893
13       1865
25       1848
7        1598
8        1515
30       1410
55       1264
155      1234
11       1203
1        1074
52       1055
Name: count, dtype: int64
```

In [30]:
```
plt.figure(figsize=(6,6))
sns.boxplot(data["Vintage"])
```

Out[30]:
```
<Axes: >
```



In [31]:
```
# the box plot chart helps in getting an all around view of price distributin acros
```

Hypothesis Testing

In [32]:
```
age_sample=data["Age"].sample(500)
age_mean=np.mean(age_sample)
age_std=np.std(age_sample)
```

In [33]:
```
ts=(age_mean-30)/(age_std/(np.sqrt(500)))
print(ts)
```

```
13.425368088166922
```

In [34]:
```
# calculating the probability

prob_z = norm.cdf(13.48,0,1)
print(prob_z)


# print p value

p1=1-prob_z
print(p1)
```

```
1.0
0.0
```

In [35]:
```
# perform statistical test to obtain p-value

ap_sample = data["Annual_Premium"].sample(50)
S2 = (np.std(ap_sample))**2
```

In [36]:
```
# compute test statistics

ts3 = (49*S2)/(10000*10000)
print(ts3)
```

```
169.84371493913608
```

In [37]:
```
# calculating the probabilit
prob = chi2.cdf(158.82,49)
print(prob)
```

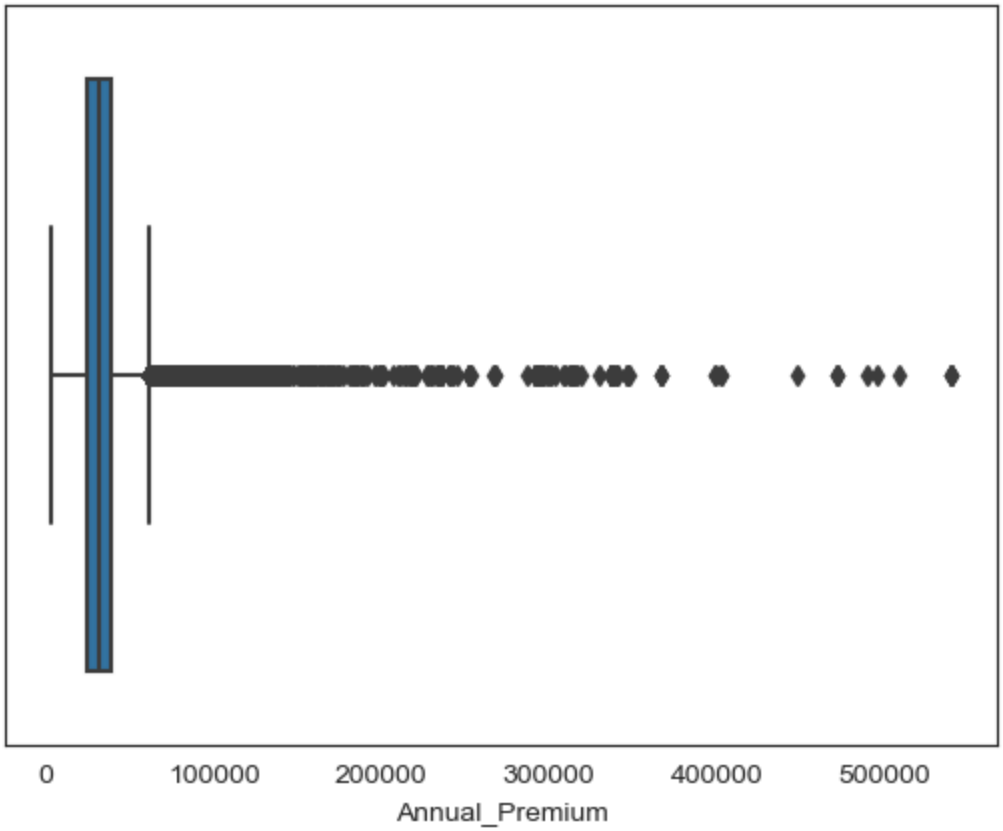
```
0.9999999999998384
```

Feature Engineering & Data Preprocessing

Handling Outliers

In [38]:
```
sns.boxplot(x=data["Annual_Premium"])
```

Out[38]:
```
<Axes: xlabel='Annual_Premium'>
```

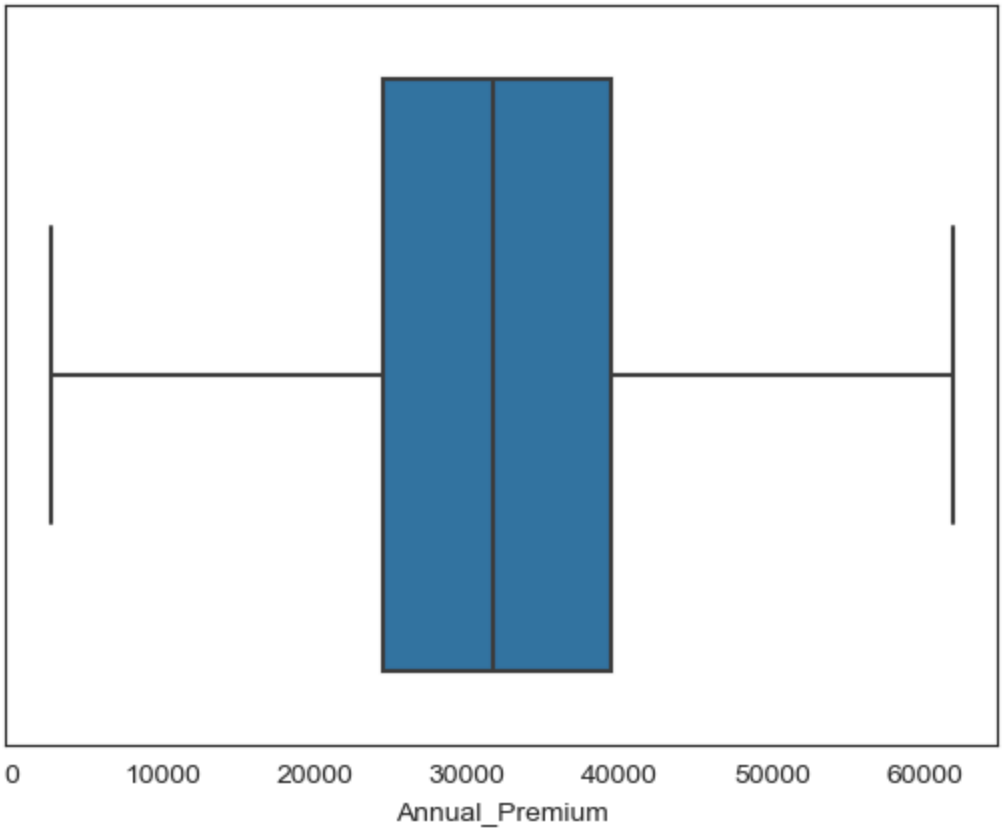


In [39]:
```
# finding the IQR


percentile25 = data["Annual_Premium"].quantile(0.25)
percentile75 = data["Annual_Premium"].quantile(0.75)
iqr = percentile75 - percentile25
upper_limit = percentile75 +1.5 * iqr
lower_limit = percentile25 -1.5 * iqr
```

In [40]:
```
# capping


data["Annual_Premium"] = np.where(
data["Annual_Premium"]>upper_limit,
upper_limit,
np.where(
data["Annual_Premium"]<lower_limit,
lower_limit,
data["Annual_Premium"]))
```

In [41]:
```
sns.boxplot(x=data["Annual_Premium"])
```

Out[41]:
```
<Axes: xlabel='Annual_Premium'>
```



Categorical Encoding

In [42]:
```
data = pd.get_dummies(data,drop_first=True,sparse=True)
```

In [43]:
```
data.head()
```

Out[43]:

	id	Age	Region_Code	Annual_Premium	Policy_Sales_Channel	Vintage	Response	Genc
0	1	44	28	40454.0	26	217	1	
1	2	76	3	33536.0	26	183	0	
2	3	47	28	38294.0	26	27	1	
3	4	21	11	28619.0	152	203	0	
4	5	29	41	27496.0	152	39	0	

In [44]:
```
data.drop("id",axis=1,inplace=True)
```

In [45]:
```
data.head()
```

Out[45]:

	Age	Region_Code	Annual_Premium	Policy_Sales_Channel	Vintage	Response	Gender_I
0	44	28	40454.0	26	217	1	
1	76	3	33536.0	26	183	0	
2	47	28	38294.0	26	27	1	
3	21	11	28619.0	152	203	0	
4	29	41	27496.0	152	39	0	

Textual Data Preprocessing

Expand Contraction

In [46]:
```
contraction = {"i=I'm":"I am",
               "Can't":"Cannot",
               "Won't":"Will not",
               }
def expand_contraction(text):
    words = text.split()
    expanded_words = [contraction.get(word,word) for word in words]
    expanded_text = " ".join(expanded_words)
    return expanded_text

# Example Usage
contracted_text = "I'm going to the store. It won't take long."
expanded_text = expand_contraction (contracted_text)
print(expanded_text)
```

```
I'm going to the store. It won't take long.
```

lower casing

In [47]:
```
text = "The Quick Born FoxJUMPS Over The LAZY Dog"
lower_case_text = text.lower()
print(lower_case_text)
```

```
the quick born foxjumps over the lazy dog
```

Removing_text

In [48]:
```
import string
```

In [49]:
```
text = "Hello,How are you"
a = text.translate(str.maketrans("","",string.punctuation))
print(a)
```

```
HelloHow are you
```

Feature Manipulation & selection

In [50]:
```
# Manipulatio Features to minimize feature correlation and creat new features
data["Driving_License_Yes"].value_counts()
```

Out[50]:
```
Driving_License_Yes
True     380297
False       812
Name: count, dtype: int64
```

Feature Selection

In [51]:
```
data.head(1)
```

Out[51]:

	Age	Region_Code	Annual_Premium	Policy_Sales_Channel	Vintage	Response	Gender_I
0	44	28	40454.0	26	217	1	

In [52]:
```
# select your features wisely to avoid overfitting
# Dropping the "Driving_Licence_Yes" columns

data.drop("Driving_License_Yes",axis=1,inplace=True)
```

In [53]:
```
data.head(1)
```

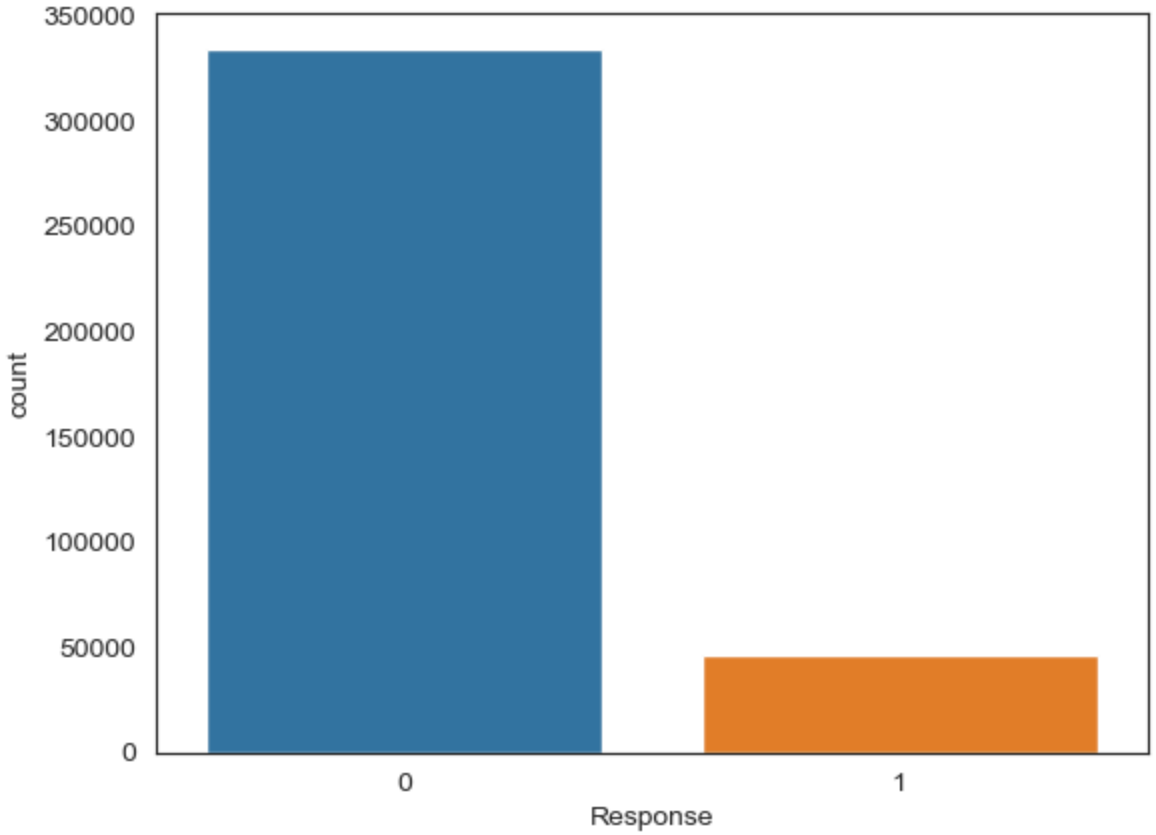
Out[53]:

	Age	Region_Code	Annual_Premium	Policy_Sales_Channel	Vintage	Response	Gender_I
0	44	28	40454.0	26	217	1	

In [54]:
```
# Handling imbalanced Dataset ( if needed)
# Target variable countplot
```

In [55]:
```
sns.countplot(x=data["Response"],data=data)
```

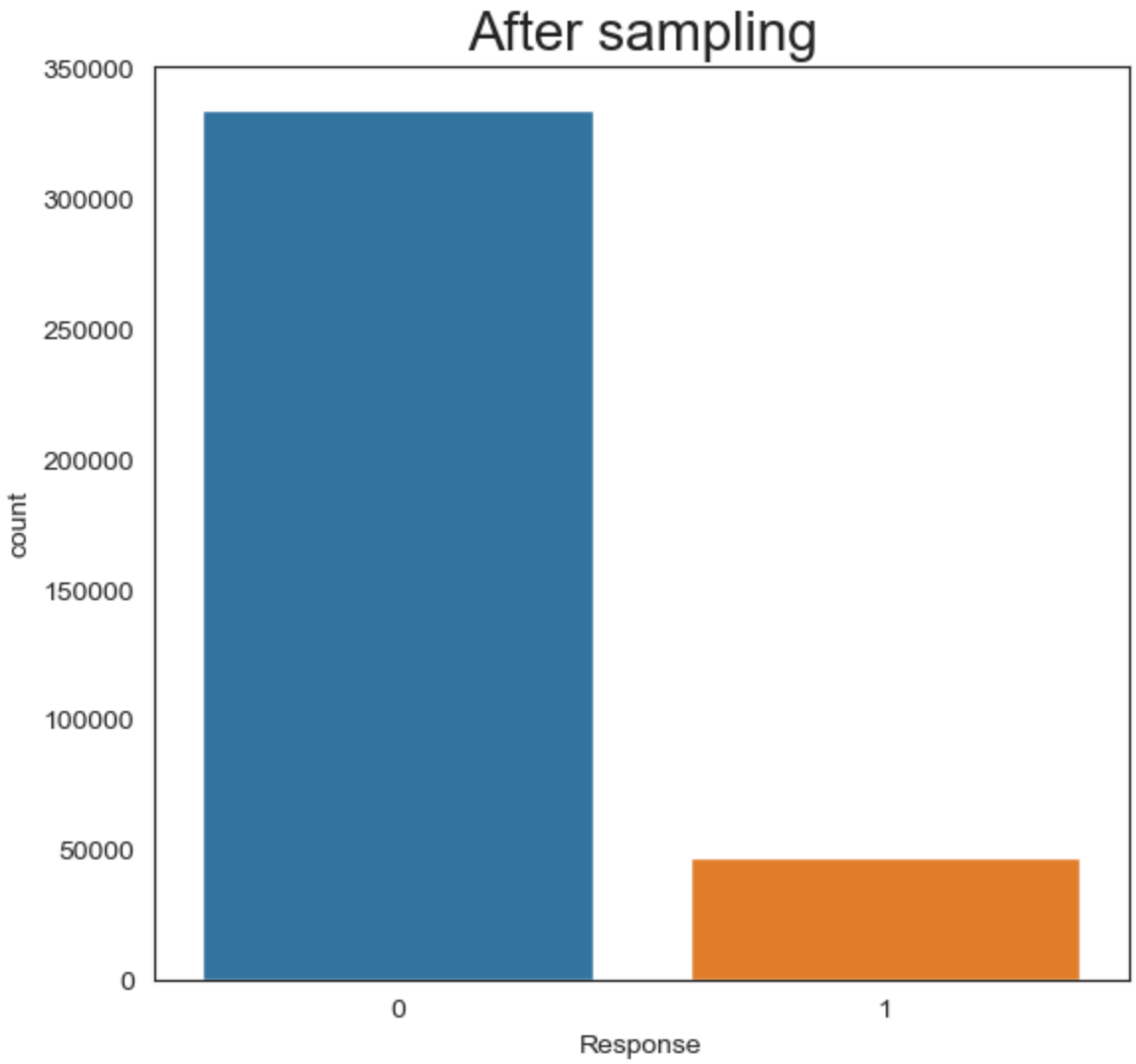
Out[55]:
```
<Axes: xlabel='Response', ylabel='count'>
```



In [56]:
```
# define x and y veriables

x=data.drop(["Response"],axis=1)
y=data["Response"]
```

In [57]:
```
# Visualized the balanced dataset
```

In [58]:
```
plt.figure(figsize=(14,6))
plt.subplot(1,2,1)
sns.countplot(x=data["Response"],data=data)
plt.title("Before sampling",fontsize=20)
plt.subplot(1,2,1)
plt.title("After sampling",fontsize=20)
plt.show()
```


After sampling
350000
300000
250000
200000
150000
100000
50000
0
count
0
1
Response

In [ ]:

Thank You