```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from scipy import stats
import seaborn as sns
```

```
df = pd.read_csv("KAG_conversion_data.csv")
df.head()
```

	ad_id	xyz_campaign_id	fb_campaign_id	age	gender	interest	Impressions	Clicks	Spent	Total_Conversion	Approved_Conversion
0	708746	916	103916	30-34	M	15	7350	1	1.43	2	1
1	708749	916	103917	30-34	M	16	17861	2	1.82	2	0
2	708771	916	103920	30-34	M	20	693	0	0.00	1	0

```
df.describe()
```

	ad_id	xyz_campaign_id	fb_campaign_id	interest	Impressions	Clicks	Spent	Total_Conversion	Approved_
count	1.143000e+03	1143.000000	1143.000000	1143.000000	1.143000e+03	1143.000000	1143.000000	1143.000000	1
mean	9.872611e+05	1067.382327	133783.989501	32.766404	1.867321e+05	33.390201	51.360656	2.855643	
std	1.939928e+05	121.629393	20500.308622	26.952131	3.127622e+05	56.892438	86.908418	4.483593	
min	7.087460e+05	916.000000	103916.000000	2.000000	8.700000e+01	0.000000	0.000000	0.000000	
25%	7.776325e+05	936.000000	115716.000000	16.000000	6.503500e+03	1.000000	1.480000	1.000000	
50%	1.121185e+06	1178.000000	144549.000000	25.000000	5.150900e+04	8.000000	12.370000	1.000000	
75%	1.121804e+06	1178.000000	144657.500000	31.000000	2.217690e+05	37.500000	60.025000	3.000000	
max	1.314415e+06	1178.000000	179982.000000	114.000000	3.052003e+06	421.000000	639.949998	60.000000	

Check if there is missing values

```
df.isna().any()
```

```
ad_id                 False
xyz_campaign_id       False
fb_campaign_id        False
age                   False
gender                False
interest              False
Impressions           False
Clicks                False
Spent                 False
Total_Conversion      False
Approved_Conversion   False
dtype: bool
```

Check Categorical Features

```
column_value = []
total_values_for_category = []
for i in df:
    if df[i].dtypes == np.object:
        column_value.append(i)
        total_values_for_category.append(len(df[i].value_counts()))
print(f"Total categorical features: {len(column_value)} and they are {column_value}")
for i in range(len(column_value)):
    print(f"column name {column_value[i]} has {total_values_for_category[i]}")
```

```
Total categorical features: 2 and they are ['age', 'gender']
column name age has 4
column name gender has 2
```

```
# Find unique values for Categorical Features
print(df['gender'].unique())
```

```
print(df['age'].unique())
print(df['xyz_campaign_id'].unique())
```

```
['M' 'F']
['30-34' '35-39' '40-44' '45-49']
[ 916  936 1178]
```

Declare new values for categorical variable

1. Gender M = 1; F = 2
2. Age 30-34 = 1; 35-39 = 2; 40-44 = 3; 45-49 = 4
3. Xyz_campaign_id: remain the same number

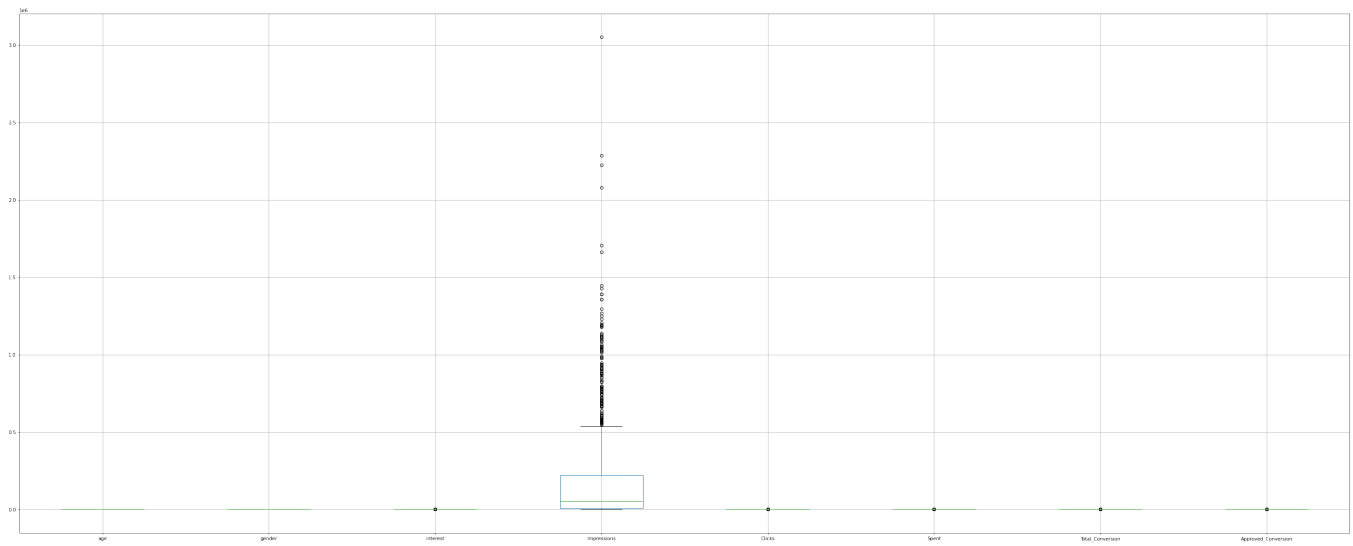
```
df['age'] = df['age'].replace(['30-34', '35-39','40-44','45-49'], [1,2,3,4])
df['gender']=df['gender'].replace(['M',"F"],[1,2])
df.head()
```

	ad_id	xyz_campaign_id	fb_campaign_id	age	gender	interest	Impressions	Clicks	Spent	Total_Conversion	Approved_Conversion
0	708746	916	103916	1	1	15	7350	1	1.43	2	1
1	708749	916	103917	1	1	16	17861	2	1.82	2	0
2	708771	916	103920	1	1	20	693	0	0.00	1	0
3	708815	916	103928	1	1	28	4259	1	1.25	1	0
4	708818	916	103928	1	1	28	4133	1	1.29	1	1

Handling Outlier

1. since first 3 columns are id, we start checking outliers from column 3
2. check zscore: >3 or <-3 is considered to be an outlier

```
plt.figure(figsize=(50,20))
pd.DataFrame.boxplot(df.iloc[:,3:])
plt.show()
```




```
for i in df.iloc[:,3:]:
#     print(i)
    val = np.where(np.abs(stats.zscore(df[i])>3))
    print(f"{i} column has {len(val[0])} outliers")
    print(val[0])
    # return outliers row number under each column name
```

```
age column has 0 outliers
[]
gender column has 0 outliers
[]
```

```
interest column has 5 outliers
[1068 1090 1114 1128 1142]
Impressions column has 23 outliers
[ 518  524  525  528  574  628  662  706  760  765  768  807  860  865
  867  884  909  912  995 1026 1123 1127 1138]
Clicks column has 33 outliers
[ 525  574  662  706  760  765  807  860  865  867  884  903  909  929
  937  949  969  970  995 1002 1003 1009 1025 1026 1027 1032 1035 1041
 1118 1123 1127 1134 1138]
Spent column has 32 outliers
[ 525  528  574  662  706  760  765  768  807  812  860  865  867  884
  903  909  929  949  969  970  995 1002 1003 1025 1026 1027 1032 1041
 1118 1123 1134 1138]
Total_Conversion column has 26 outliers
[ 518  524  525  528  531  544  561  568  574  577  579  613  628  706
  806  807  827  859  860  867 1094 1097 1101 1115 1116 1127]
Approved_Conversion column has 22 outliers
[ 518  524  525  528  531  544  561  574  577  579  613  662  765  806
  807  860  867 1032 1101 1115 1116 1127]
```

```
def bound(column):#bound-max and min
    q1=df[column].quantile(0.25)
    q3=df[column].quantile(0.75)
    IQR=q3-q1
    lower_range = q1- (1.5 * IQR)
    upper_range = q3 + (1.5 * IQR)
    return lower_range,upper_range


def outlier_detection(target):#inject list dari boundnya
    sumlower=[]
    sumupper=[]
    lower=[0]*len(target)
    upper=[0]*len(target)
    for index , i in enumerate(target):
        lower[index],upper[index]=bound(i)
        sumlower.append(lower[index])
        sumupper.append(upper[index])
    return sumlower,sumupper


def outlier_remover(target):
    sumlower,sumupper=outlier_detection(target)
    ndf=df.copy()
    for index, i in enumerate(target):
        ndf[i]=ndf[i][(ndf[i]>sumlower[index])&(ndf[i]<sumupper[index])]
    return ndf
```

```
target=['interest','Impressions','Clicks','Total_Conversion','Approved_Conversion']
df = outlier_remover(target)
df.head()
```

	ad_id	xyz_campaign_id	fb_campaign_id	age	gender	interest	Impressions	Clicks	Spent	Total_Conversion	Approved_Conversion
0	708746	916	103916	1	1	15.0	7350.0	1.0	1.43	2.0	1.0
1	708749	916	103917	1	1	16.0	17861.0	2.0	1.82	2.0	0.0
2	708771	916	103920	1	1	20.0	693.0	0.0	0.00	1.0	0.0
3	708815	916	103928	1	1	28.0	4259.0	1.0	1.25	1.0	0.0
4	708818	916	103928	1	1	28.0	4133.0	1.0	1.29	1.0	1.0

```
for i in df.iloc[:,3:]:
#     print(i)
    val = np.where(np.abs(stats.zscore(df[i])>3))
    print(f"{i} column has {len(val[0])} outliers")
    print(val[0])
```

```
age column has 0 outliers
[]
gender column has 0 outliers
[]
interest column has 0 outliers
[]
Impressions column has 0 outliers
[]
Clicks column has 0 outliers
[]
Spent column has 32 outliers
[ 525  528  574  662  706  760  765  768  807  812  860  865  867  884
  903  909  929  949  969  970  995 1002 1003 1025 1026 1027 1032 1041
 1118 1123 1134 1138]
```

```
Total_Conversion column has 0 outliers
[]
Approved_Conversion column has 0 outliers
[]
```

After removing outliers, some columns will have missing values, we need to drop the columns

```
# number of missing values for each column
df.isna().sum()
```

```
ad_id                   0
xyz_campaign_id         0
fb_campaign_id          0
age                     0
gender                  0
interest              219
Impressions           123
Clicks                127
Spent                   0
Total_Conversion      127
Approved_Conversion    95
dtype: int64
```

```
# drop missing values
df = df.dropna()
df.isna().sum()
```

```
ad_id                 0
xyz_campaign_id       0
fb_campaign_id        0
age                   0
gender                0
interest              0
Impressions           0
Clicks                0
Spent                 0
Total_Conversion      0
Approved_Conversion   0
dtype: int64
```

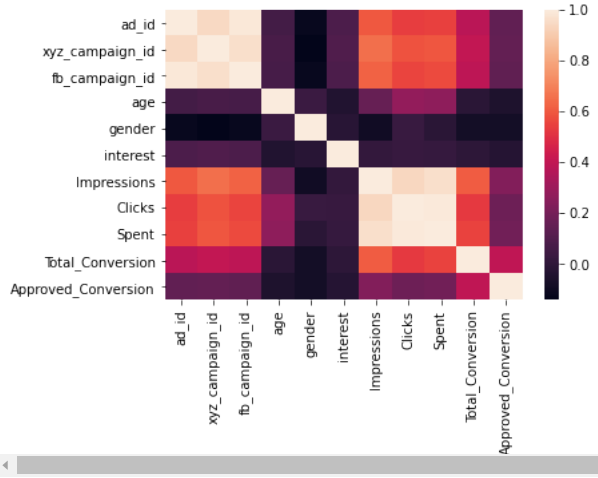
Check the correlation between variables

```
df.corr()
```

	ad_id	xyz_campaign_id	fb_campaign_id	age	gender	interest	Impressions	Clicks	Spent	Total
ad_id	1.000000	0.942176	0.989092	0.061720	-0.118701	0.085602	0.601483	0.535920	0.547113	
xyz_campaign_id	0.942176	1.000000	0.963549	0.075930	-0.142454	0.096268	0.652138	0.586111	0.596747	
fb_campaign_id	0.989092	0.963549	1.000000	0.069259	-0.116866	0.088857	0.621235	0.556666	0.567365	
age	0.061720	0.075930	0.069259	1.000000	0.033221	-0.042514	0.156826	0.278457	0.263740	
gender	-0.118701	-0.142454	-0.116866	0.033221	1.000000	-0.017931	-0.091463	0.031312	-0.014504	
interest	0.085602	0.096268	0.088857	-0.042514	-0.017931	1.000000	0.013619	0.022899	0.021766	
Impressions	0.601483	0.652138	0.621235	0.156826	-0.091463	0.013619	1.000000	0.940952	0.962588	
Clicks	0.535920	0.586111	0.556666	0.278457	0.031312	0.022899	0.940952	1.000000	0.991914	
Spent	0.547113	0.596747	0.567365	0.263740	-0.014504	0.021766	0.962588	0.991914	1.000000	
Total_Conversion	0.382822	0.403345	0.388621	-0.015494	-0.083825	-0.005272	0.607613	0.529010	0.553461	
Approved_Conversion	0.146368	0.149198	0.140045	-0.052434	-0.080276	-0.028897	0.233909	0.178625	0.191131	

```
sns.heatmap(df.corr())
```

```
<AxesSubplot:>
```

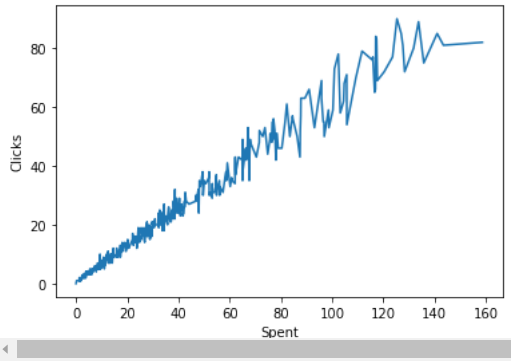


Define Independent and Dependent variables:

- Independent: gender, age, spent
- Dependent: impression, click, total_conversion, approved_conversion

```
sns.lineplot(x="Spent", y = "Clicks",data = df)
print("the more you spent on the ads, the more clicks it will generate")
```

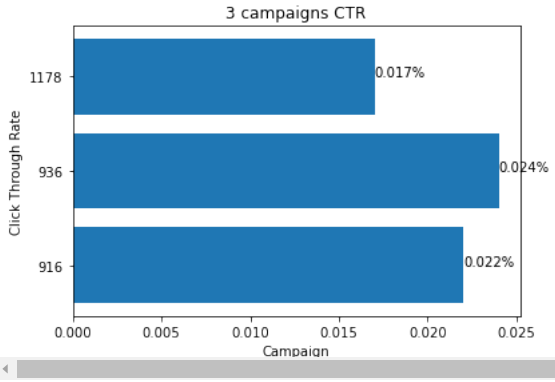
```
the more you spent on the ads, the more clicks it will generate
```



Calculate Click through rate = Clicks/Impressions

```
ads1 = df[df['xyz_campaign_id']==916]
ads2 = df[df['xyz_campaign_id']==936]
ads3 = df[df['xyz_campaign_id']==1178]
ctr_1 = round(((ads1['Clicks'].sum()/ads1['Impressions'].sum())*100),3)
ctr_2 = round(((ads2['Clicks'].sum()/ads2['Impressions'].sum())*100),3)
ctr_3 = round(((ads3['Clicks'].sum()/ads3['Impressions'].sum())*100),3)
ctr_total = [ctr_1, ctr_2, ctr_3]
x = ['916', '936', '1178']
print(ctr_total)
plt.xlabel('Campaign')
plt.ylabel("Click Through Rate")
plt.title("3 campaigns CTR")
plt.barh(x,ctr_total)
# display horizon bar chart with value label
for idx, val in enumerate(ctr_total):
    plt.text(val,idx,str(val)+"%")
```

```
[0.022, 0.024, 0.017]
```



Conclusion of CTR:

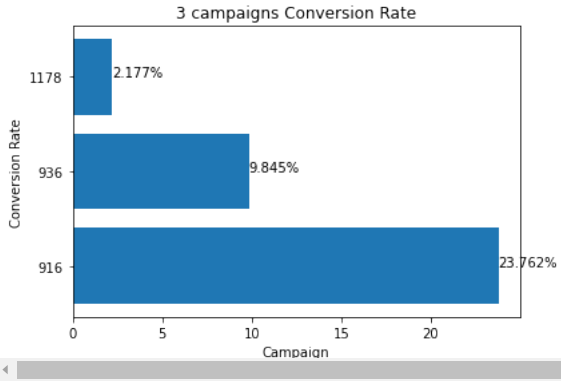
Campaign 916 and 936 have higher CTR, indicating they either have a more effective message or better targeting than campaign 1178.

Calculate Coversion rate = Approved_conversion / Clicks

- Using approved_conversion: people who bought the product after seeing the ad.

```
con_1 = round(((ads1['Approved_Conversion'].sum()/ads1['Clicks'].sum())*100),3)
con_2 = round(((ads2['Approved_Conversion'].sum()/ads2['Clicks'].sum())*100),3)
con_3 = round(((ads3['Approved_Conversion'].sum()/ads3['Clicks'].sum())*100),3)
con_total = [con_1, con_2, con_3]
x = ['916', '936', '1178']
print(con_total)
plt.xlabel('Campaign')
plt.ylabel("Conversion Rate")
plt.title("3 campaigns Conversion Rate")
plt.barh(x,con_total)
# display horizon bar chart with value label
for idx, val in enumerate(con_total):
    plt.text(val,idx,str(val)+"%")
```

```
[23.762, 9.845, 2.177]
```



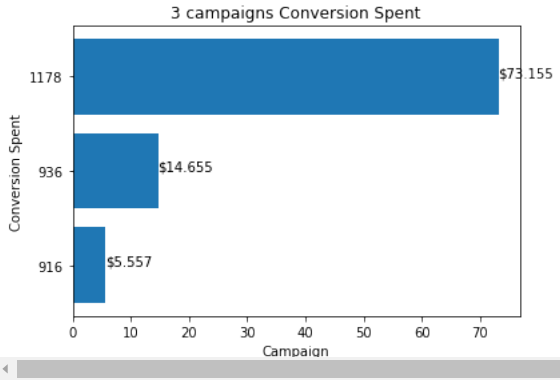
Conclusion of Conversion Rate:

Campagin 916 and 936 have much larger conversion rates than campagin 1178.

Calculate Conversion Spent = Spent / Approved_conversion

```
cc_1 = round(((ads1['Spent'].sum()/ads1['Approved_Conversion'].sum())),3)
cc_2 = round(((ads2['Spent'].sum()/ads2['Approved_Conversion'].sum())),3)
cc_3 = round(((ads3['Spent'].sum()/ads3['Approved_Conversion'].sum())),3)
cc_total = [cc_1, cc_2, cc_3]
x = ['916', '936', '1178']
print(cc_total)
plt.xlabel('Campaign')
plt.ylabel("Conversion Spent")
plt.title("3 campaigns Conversion Spent")
plt.barh(x,cc_total)
# display horizon bar chart with value label
for idx, val in enumerate(cc_total):
    plt.text(val,idx,"$"+str(val))
```

```
[5.557, 14.655, 73.155]
```



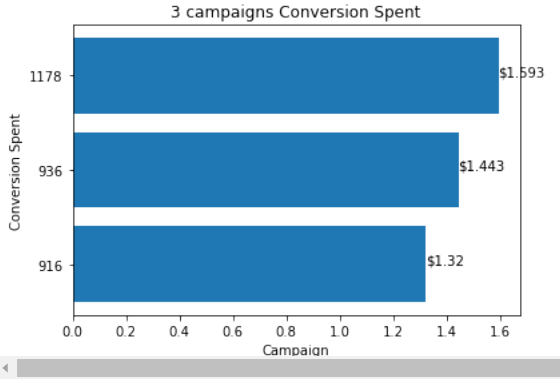
Conclusion for Conversion Spent:

Campaign 1178 having more than 4 times the next highest campagin 936. This along with the CTR above helps build a story that Campaign 1178 messaging and targeting are off as they have both lower CTR (message not resonate as much with customers) and they have a higher Coversion Spent (targeted customers who do click the ad are not actually interested in purchasing the product). Another explanation could be the cost per click for Campagin 1178 higher than the other 2 campaigns which we will now examine.

Calculate the Cost per click = Spent / Clicks

```
cpc_1 = round(((ads1['Spent'].sum()/ads1['Clicks'].sum())),3)
cpc_2 = round(((ads2['Spent'].sum()/ads2['Clicks'].sum())),3)
cpc_3 = round(((ads3['Spent'].sum()/ads3['Clicks'].sum())),3)
cpc_total = [cpc_1, cpc_2, cpc_3]
x = ['916', '936', '1178']
print(cpc_total)
plt.xlabel('Campaign')
plt.ylabel("Conversion Spent")
plt.title("3 campaigns Conversion Spent")
plt.barh(x,cpc_total)
# display horizon bar chart with value label
for idx, val in enumerate(cpc_total):
    plt.text(val,idx,"$"+str(val))
```

```
[1.32, 1.443, 1.593]
```



Conclusion on CPC: