marketing-campaigns

November 21, 2023

1 Objective of A/B test

Evaluate Campaign Effectiveness: Determine whether the Test campaign has statistically significant impact on conversion rates compared to Control campaign The dataset use in these project is ('control_group.csv','test_group.csv')

2 Identify Variables

the type of campaign(Control or Test) - independent variable

conversion rates - dependent variable

[1]:
```
dataset_description = "marketing campaigns"

sample_size_statement = f"The analysis was conducted on a dataset of 59␣
 ↪observations related to marketing campaign."

print(sample_size_statement)
```

```
The analysis was conducted on a dataset of 59 observations related to marketing
campaign.
```

3 Preparing the data

[2]:
```
import pandas as pd
import datetime
from datetime import date , timedelta
```

[3]:
```
control_data=pd.read_csv("C:/machinelearning/control_group.csv",sep=";")
test_data=pd.read_csv("C:/machinelearning/test_group.csv",sep=";")
```

[4]:
```
control_data.head()
```

[4]:

	Campaign Name	Date	Spend [USD]	# of Impressions	Reach	\
0	Control Campaign	1.08.2019	2280	82702	56930	
1	Control Campaign	2.08.2019	1757	121040	102513	
2	Control Campaign	3.08.2019	2343	131711	110862	

```
3  Control Campaign  4.08.2019         1940             72878   61235
4  Control Campaign  5.08.2019         1835            109559   88844

   # of Website Clicks  # of Searches  # of View Content  # of Add to Cart  \
0                 7016           2290               2159              1819
1                 8110           2033               1841              1219
2                 6508           1737               1549              1134
3                 3065           1042                982              1183
4                 5320           2221               1943              1300

   # of Purchase
0            618
1            511
2            372
3            340
4            522
```

[5]:
```
print(control_data)
```

```
       Campaign Name        Date  Spend [USD]  # of Impressions   Reach  \
0   Control Campaign   1.08.2019         2280             82702   56930
1   Control Campaign   2.08.2019         1757            121040  102513
2   Control Campaign   3.08.2019         2343            131711  110862
3   Control Campaign   4.08.2019         1940             72878   61235
4   Control Campaign   5.08.2019         1835            109559   88844
5   Control Campaign   6.08.2019         3083            109076   87998
6   Control Campaign   7.08.2019         2544            142123  127852
7   Control Campaign   8.08.2019         1900             90939   65217
8   Control Campaign   9.08.2019         2813            121332   94896
9   Control Campaign  10.08.2019         2149            117624   91257
10  Control Campaign  11.08.2019         2490            115247   95843
11  Control Campaign  12.08.2019         2319            116639  100189
12  Control Campaign  13.08.2019         2697             82847   68214
13  Control Campaign  14.08.2019         1875            145248  118632
14  Control Campaign  15.08.2019         2774            132845  102479
15  Control Campaign  16.08.2019         2024             71274   42859
16  Control Campaign  17.08.2019         2177            119612  106518
17  Control Campaign  18.08.2019         1876            108452   96518
18  Control Campaign  19.08.2019         2596            107890   81268
19  Control Campaign  20.08.2019         2675            113430   78625
20  Control Campaign  21.08.2019         1803             74654   59873
21  Control Campaign  22.08.2019         2939            105705   86218
22  Control Campaign  23.08.2019         2496            129880  109413
23  Control Campaign  24.08.2019         1892             72515   51987
24  Control Campaign  25.08.2019         1962            117006  100398
25  Control Campaign  26.08.2019         2233            124897   98432
26  Control Campaign  27.08.2019         2061            104678   91579
```

27	Control Campaign	28.08.2019	2421	141654	125874
28	Control Campaign	29.08.2019	2375	92029	74192
29	Control Campaign	30.08.2019	2324	111306	88632

	# of Website Clicks	# of Searches	# of View Content	# of Add to Cart	\
0	7016	2290	2159	1819	
1	8110	2033	1841	1219	
2	6508	1737	1549	1134	
3	3065	1042	982	1183	
4	5320	2221	1943	1300	
5	4028	1709	1249	784	
6	2640	1388	1106	1166	
7	7260	3047	2746	930	
8	6198	2487	2179	645	
9	2277	2475	1984	1629	
10	8137	2941	2486	1887	
11	2993	1397	1147	1439	
12	6554	2390	1975	1794	
13	4521	1209	1149	1339	
14	4896	1179	1005	1641	
15	5224	2427	2158	1613	
16	6628	1756	1642	878	
17	7253	2447	2115	1695	
18	3706	2483	2098	908	
19	2578	1001	848	1709	
20	5691	2711	2496	1460	
21	6843	3102	2988	819	
22	4410	2896	2496	1913	
23	4085	1274	1149	1146	
24	4234	2423	2096	883	
25	5435	2847	2421	1448	
26	4941	3549	3249	980	
27	6287	1672	1589	1711	
28	8127	4891	4219	1486	
29	4658	1615	1249	442	

	# of Purchase
0	618
1	511
2	372
3	340
4	522
5	764
6	499
7	462
8	501
9	734
10	475

```
11            794
12            766
13            788
14            366
15            438
16            222
17            243
18            542
19            299
20            800
21            387
22            766
23            585
24            386
25            251
26            605
27            643
28            334
29            670
```

[6]:
```
test_data.head()
```

[6]:
```
   Campaign Name       Date  Spend [USD]  # of Impressions  Reach  \
0  Test Campaign  1.08.2019         3008             39550  35820
1  Test Campaign  2.08.2019         2542            100719  91236
2  Test Campaign  3.08.2019         2365             70263  45198
3  Test Campaign  4.08.2019         2710             78451  25937
4  Test Campaign  5.08.2019         2297            114295  95138

   # of Website Clicks  # of Searches  # of View Content  # of Add to Cart  \
0                 3038           1946               1069               894
1                 4657           2359               1548               879
2                 7885           2572               2367              1268
3                 4216           2216               1437               566
4                 5863           2106                858               956

   # of Purchase
0            255
1            677
2            578
3            340
4            768
```

[7]:
```
control_data.columns=["Campaign Name","Date","Amount Spend","Number of␣
↪Impressions","Reach","Website Clicks","Searches recieved","Content␣
↪Viewed","Added to Cart","Purchases"]
```

```
test_data.columns=["Campaign Name","Date","Amount Spend","Number of␣
 ↪Impressions","Reach","Website Clicks","Searches recieved","Content␣
 ↪Viewed","Added to Cart","Purchases"]
```

[8]:
```
ab_data=control_data.merge(test_data,how="outer").sort_values(["Date"])
ab_data=ab_data.reset_index(drop=True)
print(ab_data.head())
```

```
      Campaign Name        Date  Amount Spend  Number of Impressions  Reach  \
0  Control Campaign   1.08.2019          2280                  82702  56930
1     Test Campaign   1.08.2019          3008                  39550  35820
2     Test Campaign  10.08.2019          2790                  95054  79632
3  Control Campaign  10.08.2019          2149                 117624  91257
4     Test Campaign  11.08.2019          2420                  83633  71286

   Website Clicks  Searches recieved  Content Viewed  Added to Cart  Purchases
0            7016               2290            2159           1819        618
1            3038               1946            1069            894        255
2            8125               2312            1804            424        275
3            2277               2475            1984           1629        734
4            3750               2893            2617           1075        668
```

In our dataset the conversion rates were calculated by dividing the number of purchases by the number of website clicks for each observation and expressing the result as percentage The 'Conversion Rate' column now represents the percentage of successful conversions for each corresponding entry, providing insights into the effectiveness of the marketing campaigns in driving user engagement and purchases

[9]:
```
df=pd.DataFrame(ab_data)

df["Conversion Rate"]=(df["Purchases"]/df["Website Clicks"])*100

df.head()
```

[9]:
```
      Campaign Name        Date  Amount Spend  Number of Impressions  Reach  \
0  Control Campaign   1.08.2019          2280                  82702  56930
1     Test Campaign   1.08.2019          3008                  39550  35820
2     Test Campaign  10.08.2019          2790                  95054  79632
3  Control Campaign  10.08.2019          2149                 117624  91257
4     Test Campaign  11.08.2019          2420                  83633  71286

   Website Clicks  Searches recieved  Content Viewed  Added to Cart  \
0            7016               2290            2159           1819
1            3038               1946            1069            894
2            8125               2312            1804            424
3            2277               2475            1984           1629
4            3750               2893            2617           1075
```

	Purchases	Conversion Rate
0	618	8.808438
1	255	8.393680
2	275	3.384615
3	734	32.235397
4	668	17.813333

Assigning binary labels to Conversion Rate

[10]:
```
threshold = 9

df["Conversion Label"] = (df["Conversion Rate"] > threshold).astype(int)

print("DataFrame with Conversion Rates:")

print(df)
```

```
DataFrame with Conversion Rates:
       Campaign Name        Date  Amount Spend  Number of Impressions   Reach  \
0   Control Campaign   1.08.2019          2280                  82702   56930
1      Test Campaign   1.08.2019          3008                  39550   35820
2      Test Campaign  10.08.2019          2790                  95054   79632
3   Control Campaign  10.08.2019          2149                 117624   91257
4      Test Campaign  11.08.2019          2420                  83633   71286
5   Control Campaign  11.08.2019          2490                 115247   95843
6      Test Campaign  12.08.2019          2831                 124591   10598
7   Control Campaign  12.08.2019          2319                 116639  100189
8      Test Campaign  13.08.2019          1972                  65827   49531
9   Control Campaign  13.08.2019          2697                  82847   68214
10     Test Campaign  14.08.2019          2537                  56304   25982
11  Control Campaign  14.08.2019          1875                 145248  118632
12     Test Campaign  15.08.2019          2516                  94338   76219
13  Control Campaign  15.08.2019          2774                 132845  102479
14  Control Campaign  16.08.2019          2024                  71274   42859
15     Test Campaign  16.08.2019          3076                 106584   81389
16  Control Campaign  17.08.2019          2177                 119612  106518
17     Test Campaign  17.08.2019          1968                  95843   54389
18  Control Campaign  18.08.2019          1876                 108452   96518
19     Test Campaign  18.08.2019          1979                  53632   43241
20  Control Campaign  19.08.2019          2596                 107890   81268
21     Test Campaign  19.08.2019          2626                  22521   10698
22  Control Campaign   2.08.2019          1757                 121040  102513
23     Test Campaign   2.08.2019          2542                 100719   91236
24  Control Campaign  20.08.2019          2675                 113430   78625
25     Test Campaign  20.08.2019          2712                  39470   31893
26  Control Campaign  21.08.2019          1803                  74654   59873
27     Test Campaign  21.08.2019          3112                 133771  109834
28  Control Campaign  22.08.2019          2939                 105705   86218
```

29	Test Campaign	22.08.2019	2899	34752	27932
30	Control Campaign	23.08.2019	2496	129880	109413
31	Test Campaign	23.08.2019	2407	60286	49329
32	Control Campaign	24.08.2019	1892	72515	51987
33	Test Campaign	24.08.2019	2078	36650	30489
34	Control Campaign	25.08.2019	1962	117006	100398
35	Test Campaign	25.08.2019	2928	120576	105978
36	Control Campaign	26.08.2019	2233	124897	98432
37	Test Campaign	26.08.2019	2311	80841	61589
38	Control Campaign	27.08.2019	2061	104678	91579
39	Test Campaign	27.08.2019	2915	111469	92159
40	Control Campaign	28.08.2019	2421	141654	125874
41	Test Campaign	28.08.2019	2247	54627	41267
42	Test Campaign	29.08.2019	2805	67444	43219
43	Control Campaign	29.08.2019	2375	92029	74192
44	Test Campaign	3.08.2019	2365	70263	45198
45	Control Campaign	3.08.2019	2343	131711	110862
46	Control Campaign	30.08.2019	2324	111306	88632
47	Test Campaign	30.08.2019	1977	120203	89380
48	Test Campaign	4.08.2019	2710	78451	25937
49	Control Campaign	4.08.2019	1940	72878	61235
50	Test Campaign	5.08.2019	2297	114295	95138
51	Control Campaign	5.08.2019	1835	109559	88844
52	Test Campaign	6.08.2019	2458	42684	31489
53	Control Campaign	6.08.2019	3083	109076	87998
54	Test Campaign	7.08.2019	2838	53986	42148
55	Control Campaign	7.08.2019	2544	142123	127852
56	Test Campaign	8.08.2019	2916	33669	20149
57	Control Campaign	8.08.2019	1900	90939	65217
58	Control Campaign	9.08.2019	2813	121332	94896
59	Test Campaign	9.08.2019	2652	45511	31598

	Website Clicks	Searches recieved	Content Viewed	Added to Cart	\
0	7016	2290	2159	1819	
1	3038	1946	1069	894	
2	8125	2312	1804	424	
3	2277	2475	1984	1629	
4	3750	2893	2617	1075	
5	8137	2941	2486	1887	
6	8264	2081	1992	1382	
7	2993	1397	1147	1439	
8	7568	2213	2058	1391	
9	6554	2390	1975	1794	
10	3993	1979	1059	779	
11	4521	1209	1149	1339	
12	4993	2537	1609	1090	
13	4896	1179	1005	1641	
14	5224	2427	2158	1613	

15	6800	2661	2594	1059
16	6628	1756	1642	878
17	7910	1995	1576	383
18	7253	2447	2115	1695
19	6909	2824	2522	461
20	3706	2483	2098	908
21	7617	2924	2801	788
22	8110	2033	1841	1219
23	4657	2359	1548	879
24	2578	1001	848	1709
25	6050	2061	1894	1047
26	5691	2711	2496	1460
27	5471	1995	1868	278
28	6843	3102	2988	819
29	4431	1983	1131	367
30	4410	2896	2496	1913
31	5077	2592	2004	632
32	4085	1274	1149	1146
33	7156	2687	2427	327
34	4234	2423	2096	883
35	3596	2937	2551	1228
36	5435	2847	2421	1448
37	3820	2037	1046	346
38	4941	3549	3249	980
39	6435	2976	2552	992
40	6287	1672	1589	1711
41	8144	2432	1281	1009
42	7651	1920	1240	1168
43	8127	4891	4219	1486
44	7885	2572	2367	1268
45	6508	1737	1549	1134
46	4658	1615	1249	442
47	4399	2978	1625	1034
48	4216	2216	1437	566
49	3065	1042	982	1183
50	5863	2106	858	956
51	5320	2221	1943	1300
52	7488	1854	1073	882
53	4028	1709	1249	784
54	4221	2733	2182	1301
55	2640	1388	1106	1166
56	7184	2867	2194	1240
57	7260	3047	2746	930
58	6198	2487	2179	645
59	8259	2899	2761	1200

	Purchases	Conversion Rate	Conversion Label
0	618	8.808438	0

1	255	8.393680	0
2	275	3.384615	0
3	734	32.235397	1
4	668	17.813333	1
5	475	5.837532	0
6	709	8.579380	0
7	794	26.528567	1
8	812	10.729387	1
9	766	11.687519	1
10	340	8.514901	0
11	788	17.429772	1
12	398	7.971160	0
13	366	7.475490	0
14	438	8.384380	0
15	487	7.161765	0
16	222	3.349427	0
17	238	3.008850	0
18	243	3.350338	0
19	257	3.719786	0
20	542	14.624933	1
21	512	6.721806	0
22	511	6.300863	0
23	677	14.537256	1
24	299	11.598138	1
25	730	12.066116	1
26	800	14.057283	1
27	245	4.478158	0
28	387	5.655414	0
29	276	6.228842	0
30	766	17.369615	1
31	473	9.316526	1
32	585	14.320685	1
33	269	3.759083	0
34	386	9.116675	1
35	651	18.103448	1
36	251	4.618215	0
37	284	7.434555	0
38	605	12.244485	1
39	771	11.981352	1
40	643	10.227453	1
41	721	8.853143	0
42	677	8.848517	0
43	334	4.109758	0
44	578	7.330374	0
45	372	5.716042	0
46	670	14.383856	1
47	572	13.002955	1
48	340	8.064516	0

```
49        340        11.092985                1
50        768        13.099096                1
51        522         9.812030                1
52        488         6.517094                0
53        764        18.967229                1
54        890        21.085051                1
55        499        18.901515                1
56        431         5.999443                0
57        462         6.363636                0
58        501         8.083253                0
59        845        10.231263                1
```

[11]:
```
label_counts=df["Conversion Label"].value_counts()

print("The Number of Zeroes:",label_counts[0])
print("The Number of Ones:",label_counts[1])
```

```
The Number of Zeroes: 32
The Number of Ones: 28
```

[12]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 60 entries, 0 to 59
Data columns (total 12 columns):
 #   Column                 Non-Null Count  Dtype
---  ------                 --------------  -----
 0   Campaign Name          60 non-null     object
 1   Date                   60 non-null     object
 2   Amount Spend           60 non-null     int64
 3   Number of Impressions  60 non-null     int64
 4   Reach                  60 non-null     int64
 5   Website Clicks         60 non-null     int64
 6   Searches recieved      60 non-null     int64
 7   Content Viewed         60 non-null     int64
 8   Added to Cart          60 non-null     int64
 9   Purchases              60 non-null     int64
 10  Conversion Rate        60 non-null     float64
 11  Conversion Label       60 non-null     int32
dtypes: float64(1), int32(1), int64(8), object(2)
memory usage: 5.5+ KB
```

[13]:
```
ab_data['Campaign Name'].value_counts()
```

[13]:
```
Control Campaign    30
Test Campaign       30
Name: Campaign Name, dtype: int64
```

4 Visualising the results

[14]:
```
import numpy as np
import scipy.stats as stats
```

[29]:
```
conversion_rates=ab_data.groupby('Campaign Name')['Conversion Rate']

std_p=lambda x:np.std(x,ddof=0)
se_p=lambda x:stats.sem(x,ddof=0)

conversion_rates=conversion_rates.agg([np.mean,std_p,se_p])
conversion_rates.columns=['conversion_rate','std_deviation','std_error']

conversion_rates.style.format('{:,.3f}')
```

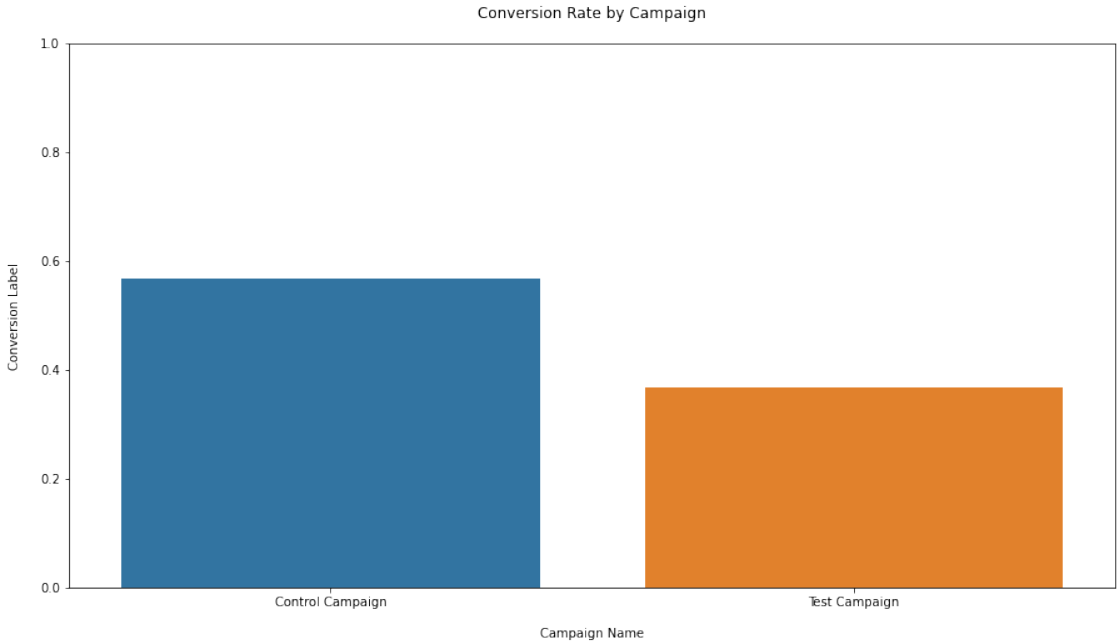
[29]:
```
<pandas.io.formats.style.Styler at 0x21406124dc0>
```

[30]:
```
import matplotlib.pyplot as plt
import seaborn as sns
```

[31]:
```
plt.figure(figsize=(15,8))

sns.barplot(x=ab_data['Campaign Name'],y=ab_data['Conversion Label'],ci=False)

plt.ylim(0,1)
plt.title('Conversion Rate by Campaign',pad=20)
plt.xlabel('Campaign Name',labelpad=15)
plt.ylabel('Conversion Label',labelpad=15)
plt.show()
```



So the control campaign 's value is higher .Is this difference statistically significant?

so as we can see the visuals and also from the stats calulated above we can conclude that the control campaign has statistically significant on conversion rates compared to test campaign.

[ ]:

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