In [3]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

In [4]:
```
df=pd.read_csv('marketing_AB.csv')
```

In [5]:
```
df.head()
```

Out[5]:

	Unnamed: 0	user id	test group	converted	total ads	most ads day	most ads hour
0	0	1069124	ad	False	130	Monday	20
1	1	1119715	ad	False	93	Tuesday	22
2	2	1144181	ad	False	21	Tuesday	18
3	3	1435133	ad	False	355	Tuesday	10
4	4	1015700	ad	False	276	Friday	14

In [6]:
```
df.duplicated(subset='user id').sum()
```

Out[6]:
```
0
```

In [7]:
```
df.drop(['Unnamed: 0','user id'], axis=1, inplace=True)
```

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

Out[8]:
```
Index(['test group', 'converted', 'total ads', 'most ads day',
       'most ads hour'],
      dtype='object')
```

In [9]:
```
df_cat = df[['test group', 'converted', 'most ads day',
       'most ads hour']]
df_cat.nunique()
```

Out[9]:
```
test group        2
converted         2
most ads day      7
most ads hour    24
dtype: int64
```

In [10]:
```
for i in df_cat:
    print(i.upper(),':',df_cat[i].unique())
```

```
TEST GROUP : ['ad' 'psa']
CONVERTED : [False  True]
MOST ADS DAY : ['Monday' 'Tuesday' 'Friday' 'Saturday' 'Wednesday' 'Sunday' 'Thursda
y']
MOST ADS HOUR : [20 22 18 10 14 13 19 11 12 16 21  3 23  4  8  0  2 15  1  6 17  7  9
5]
```

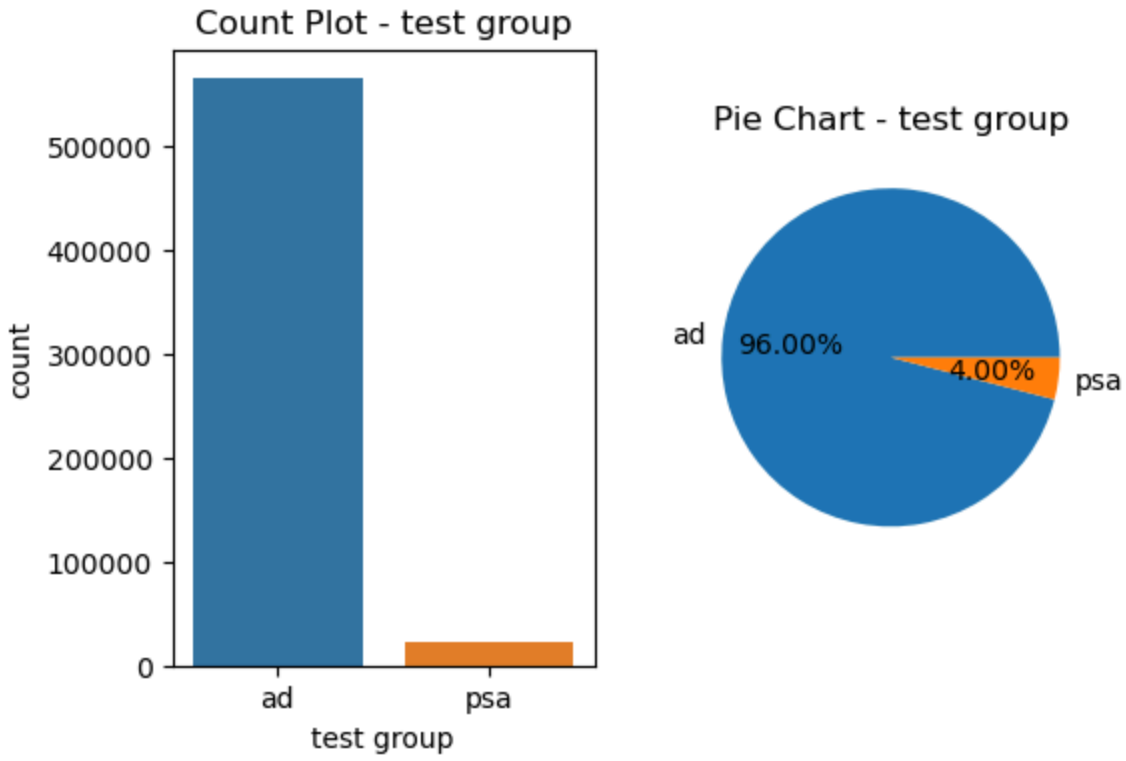
UNIVARIATE ANALYSIS

In [11]:
```
variable = 'test group'
```

```
plt.figure(figsize=(6,4))
plt.subplot(1,2,1)
sns.countplot(x=variable, data=df_cat)
plt.title(f'Count Plot - {variable}')

plt.subplot(1,2,2)
counts = df_cat[variable].value_counts()
plt.pie(counts, labels=counts.index, autopct = '%0.2f%%')
plt.title(f'Pie Chart - {variable}')
```

Out[11]:
```
Text(0.5, 1.0, 'Pie Chart - test group')
```

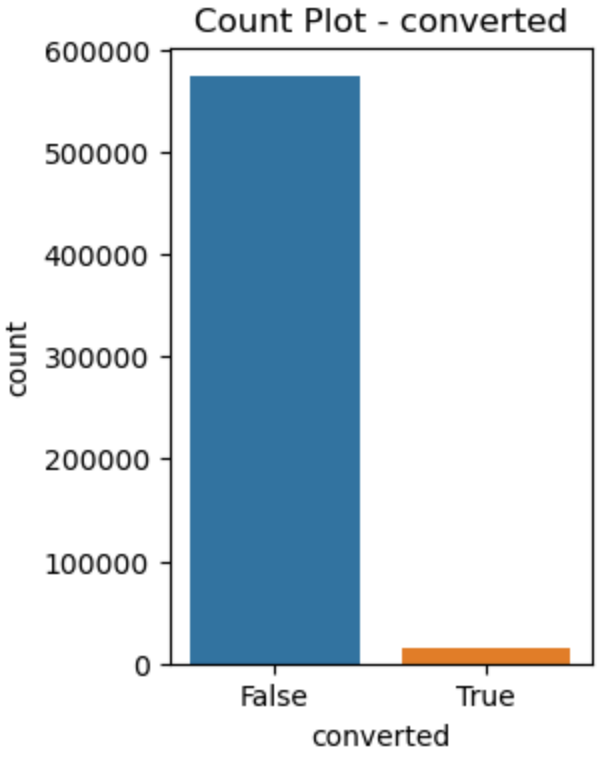


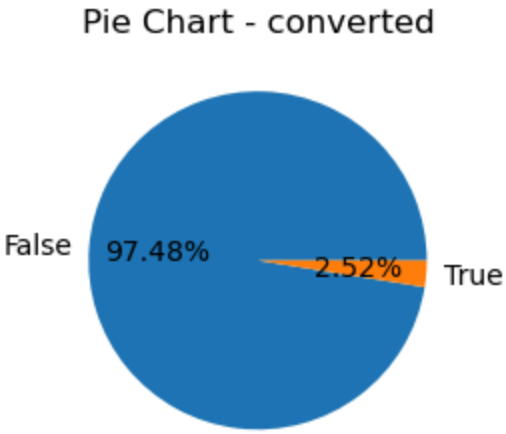
In [12]:
```
variable = 'converted'

plt.figure(figsize=(6,4))
plt.subplot(1,2,1)
sns.countplot(x=variable, data=df_cat)
plt.title(f'Count Plot - {variable}')

plt.subplot(1,2,2)
counts = df_cat[variable].value_counts()
plt.pie(counts, labels=counts.index, autopct = '%0.2f%%')
plt.title(f'Pie Chart - {variable}')
```

Out[12]:
```
Text(0.5, 1.0, 'Pie Chart - converted')
```



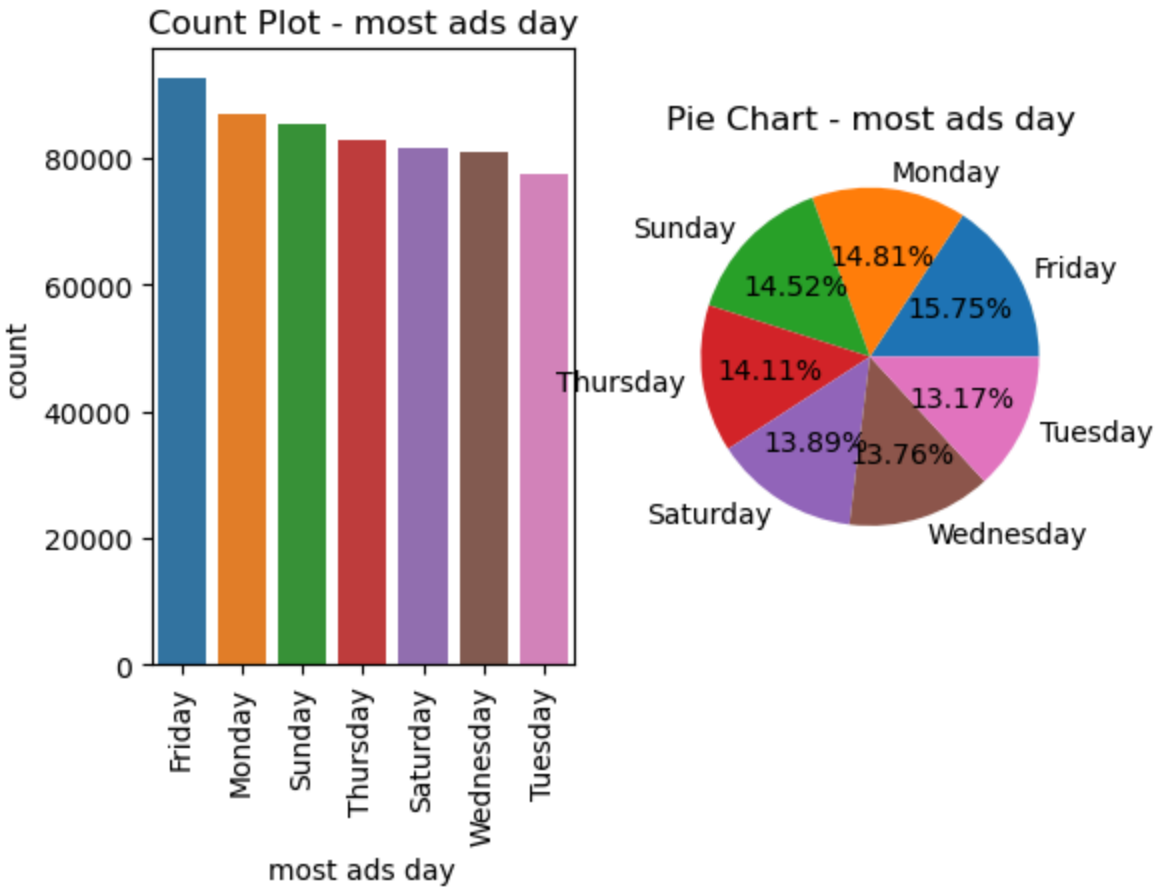


In [13]:
```
variable = 'most ads day'

plt.figure(figsize=(6,4))
plt.subplot(1,2,1)
sns.countplot(x=variable, data=df_cat, order=df_cat['most ads day'].value_counts().inc
plt.title(f'Count Plot - {variable}')
plt.xticks(rotation = 90)

plt.subplot(1,2,2)
counts = df_cat[variable].value_counts()
plt.pie(counts, labels=counts.index, autopct = '%0.2f%%')
plt.title(f'Pie Chart - {variable}')
```

Out[13]:
```
Text(0.5, 1.0, 'Pie Chart - most ads day')
```

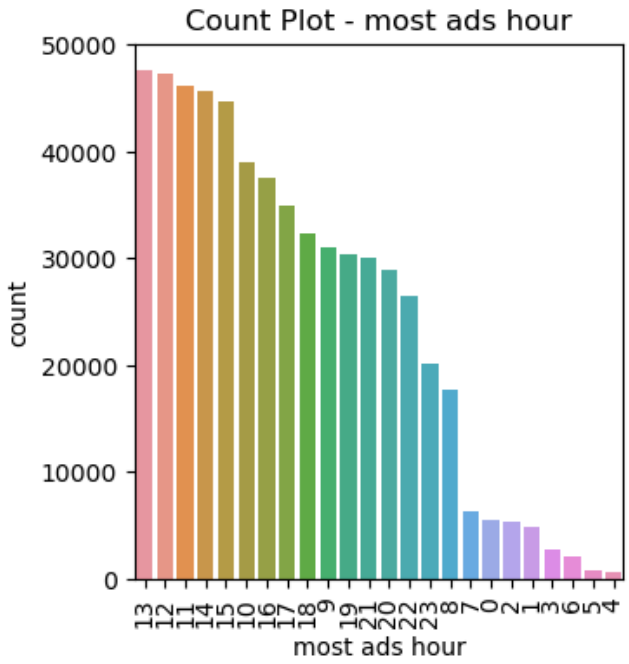


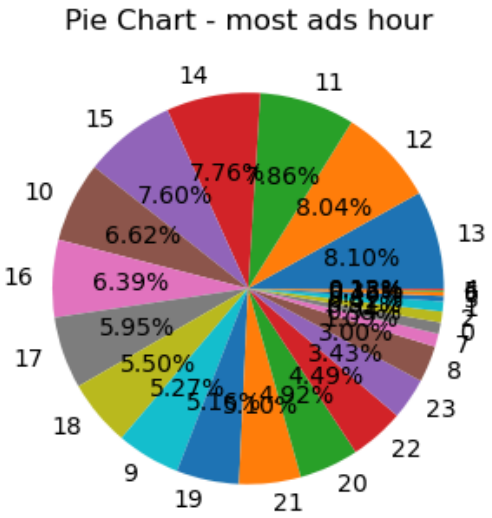
In [14]:
```
variable = 'most ads hour'

plt.figure(figsize=(8,4))
plt.subplot(1,2,1)
sns.countplot(x=variable, data=df_cat, order=df_cat['most ads hour'].value_counts().ir
plt.title(f'Count Plot - {variable}')
plt.xticks(rotation = 90)

plt.subplot(1,2,2)
counts = df_cat[variable].value_counts()
plt.pie(counts, labels=counts.index, autopct = '%0.2f%%')
plt.title(f'Pie Chart - {variable}')
```

Out[14]:
```
Text(0.5, 1.0, 'Pie Chart - most ads hour')
```



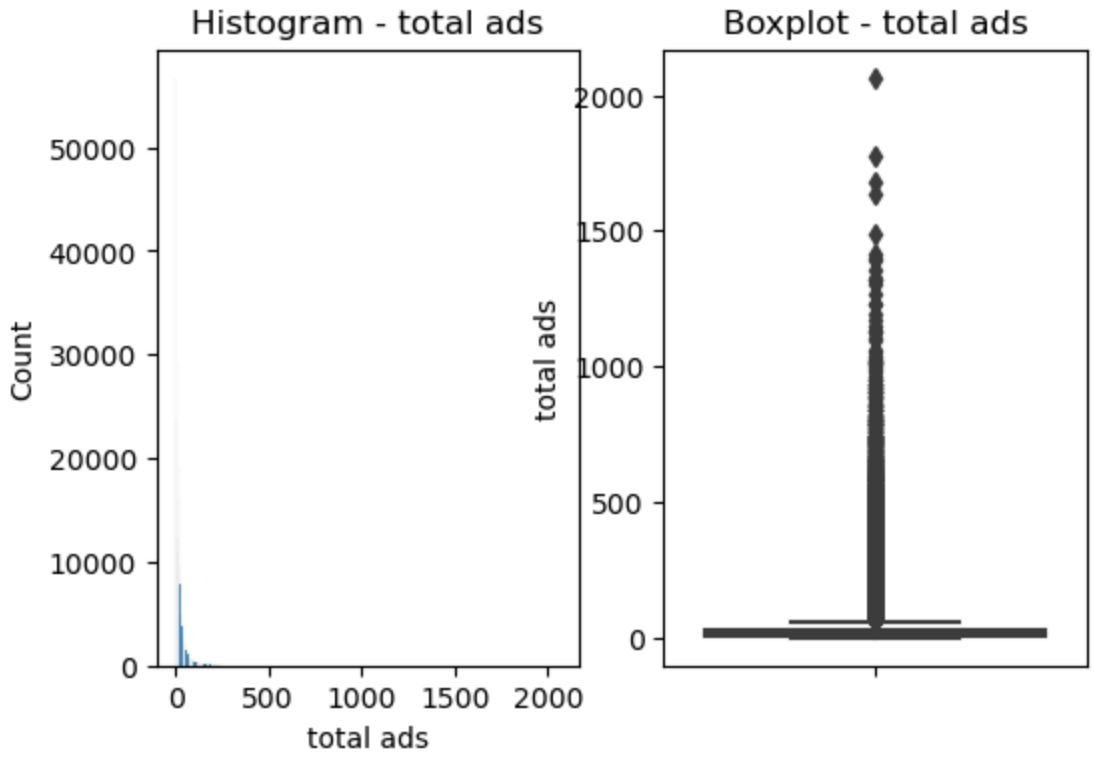


In [15]:
```
variable = 'total ads'

plt.figure(figsize=(6,4))
plt.subplot(1,2,1)
sns.histplot(x=variable, data=df)
plt.title(f'Histogram - {variable}')

plt.subplot(1,2,2)
sns.boxplot(y=variable, data=df)
plt.title(f'Boxplot - {variable}')
```

Out[15]:
```
Text(0.5, 1.0, 'Boxplot - total ads')
```

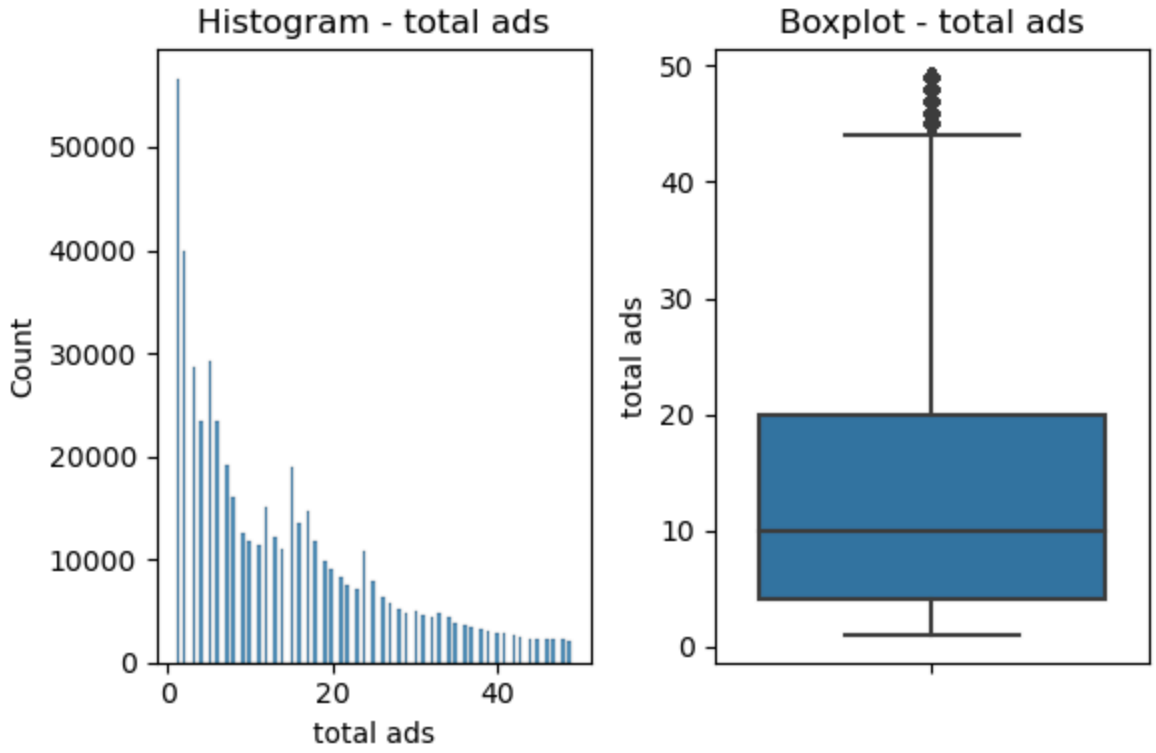


In [16]:
```
variable = 'total ads'

plt.figure(figsize=(6,4))
plt.subplot(1,2,1)
sns.histplot(x=variable, data=df[df['total ads'] < 50])
plt.title(f'Histogram - {variable}')

plt.subplot(1,2,2)
sns.boxplot(y=variable, data=df[df['total ads'] < 50])
plt.title(f'Boxplot - {variable}')

plt.tight_layout()
```



BIVARAITE ANALYSIS

In [17]:
```
df.columns
```

Out[17]:
```
Index(['test group', 'converted', 'total ads', 'most ads day',
       'most ads hour'],
      dtype='object')
```

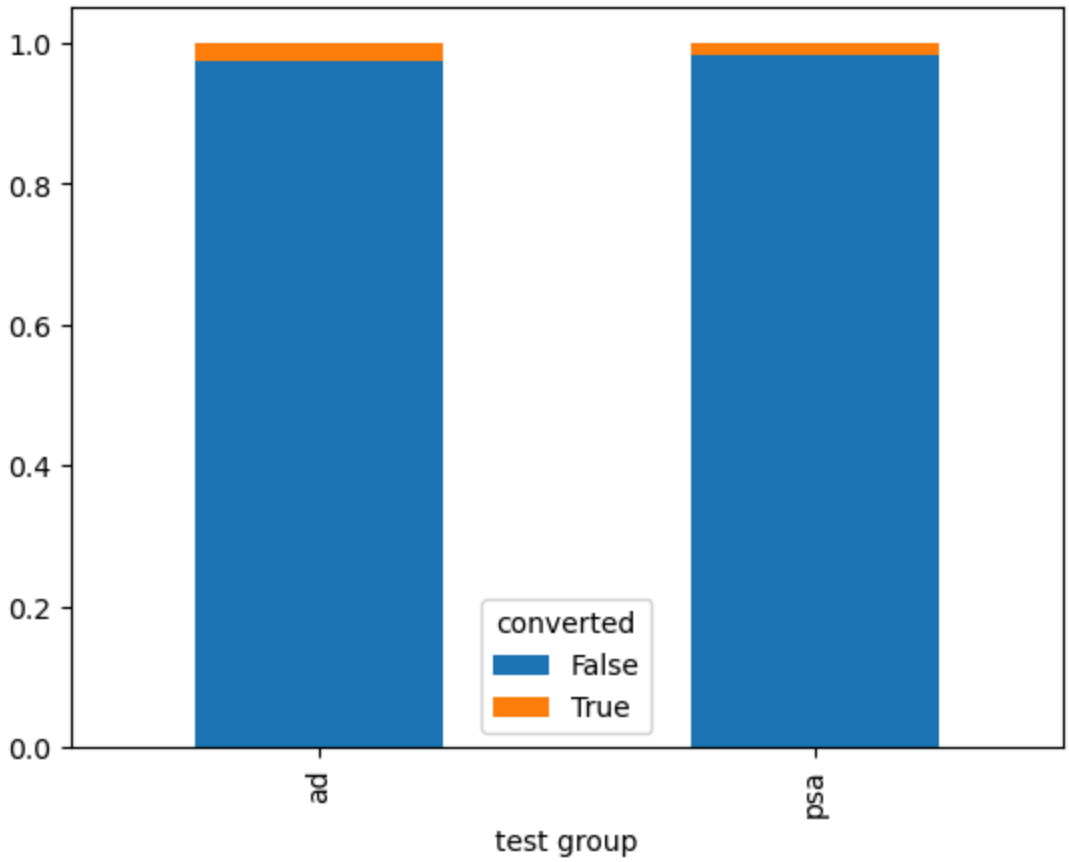
In [18]:
```
cat_conv_test_grp = pd.crosstab(df['test group'],df['converted'], normalize='index')
cat_conv_test_grp
```

Out[18]:

converted	False	True
test group		
ad	0.974453	0.025547
psa	0.982146	0.017854

In [19]:
```
cat_conv_test_grp.plot.bar(stacked=True)
```

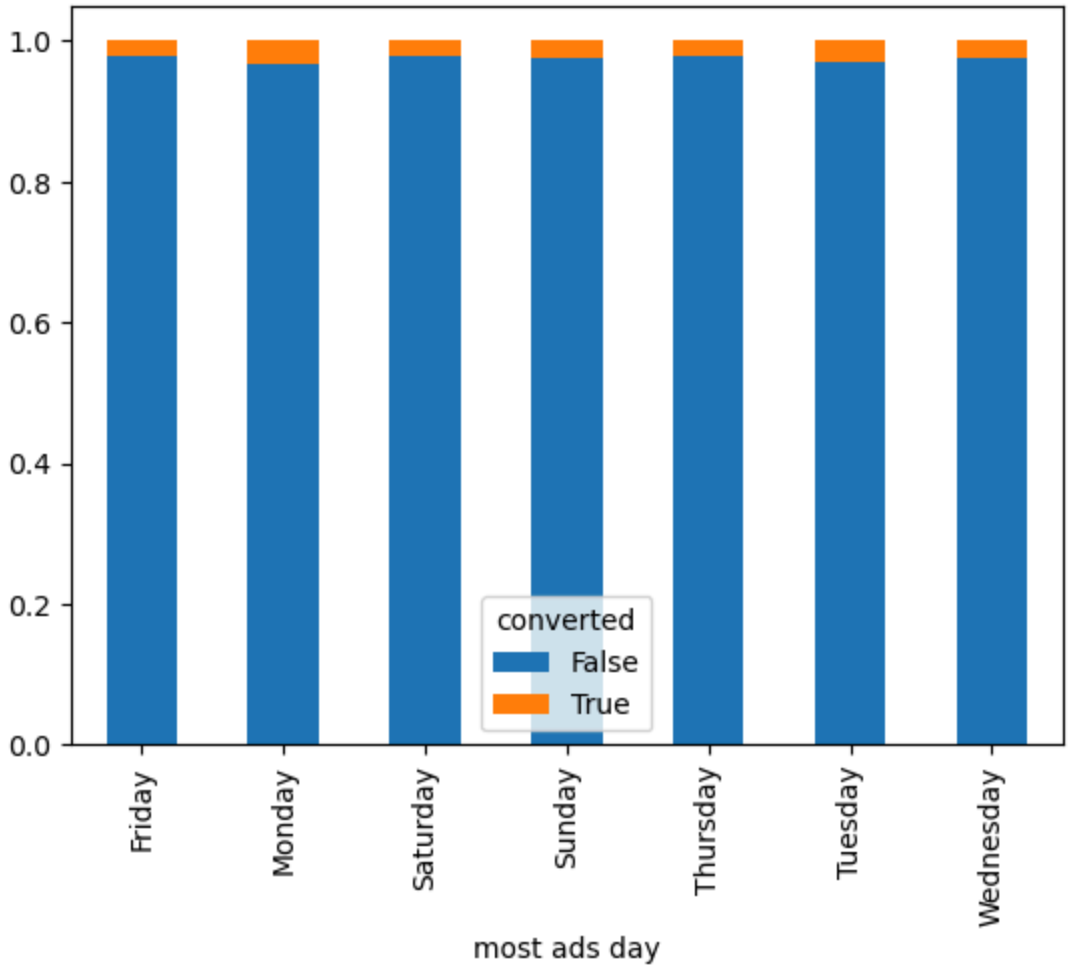
Out[19]: <Axes: xlabel='test group'>



In [20]:
```
cat_conv_day = pd.crosstab(df['most ads day'],df['converted'], normalize='index')
print(cat_conv_day.sort_values(by=True,ascending=False))
cat_conv_day.plot.bar(stacked=True)
```

```
converted        False     True
most ads day
Monday        0.967188  0.032812
Tuesday       0.970160  0.029840
Wednesday     0.975058  0.024942
Sunday        0.975524  0.024476
Friday        0.977788  0.022212
Thursday      0.978429  0.021571
Saturday      0.978949  0.021051
```

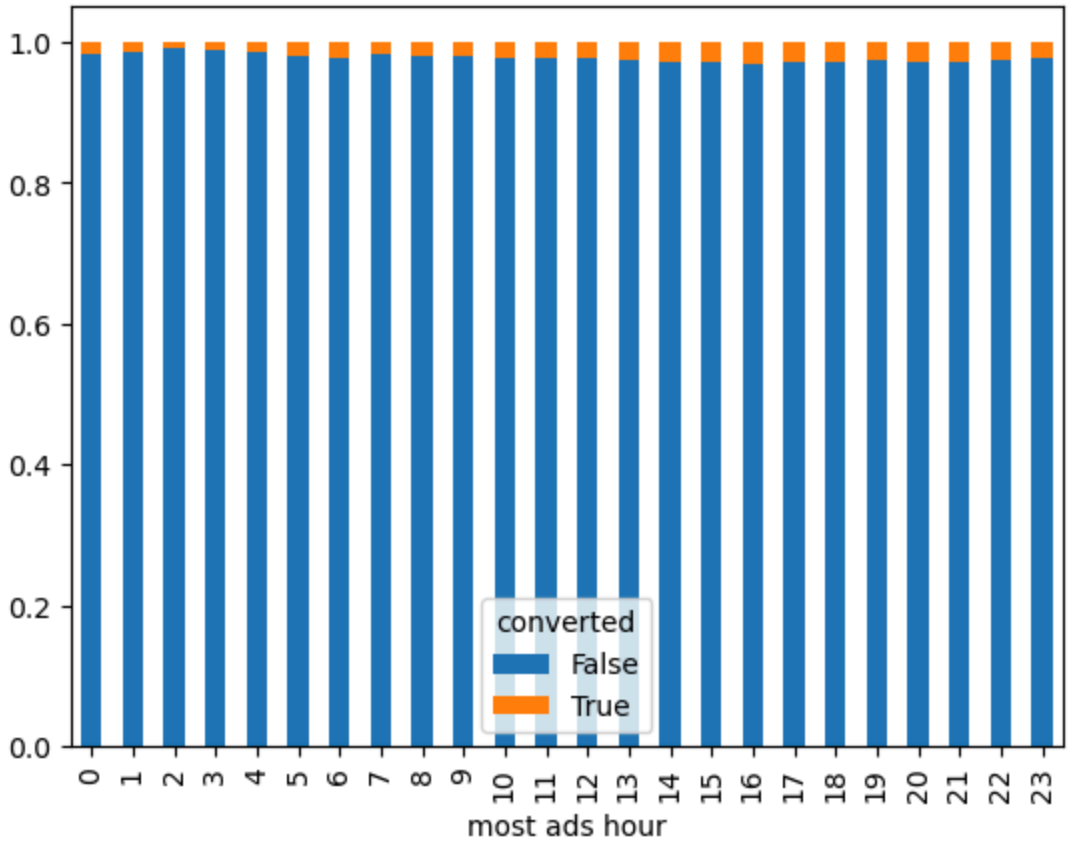
Out[20]: <Axes: xlabel='most ads day'>



In [21]:
```
cat_conv_hour = pd.crosstab(df['most ads hour'],df['converted'], normalize='index')
print(cat_conv_hour.sort_values(by=True,ascending=False))
cat_conv_hour.plot.bar(stacked=True)
```

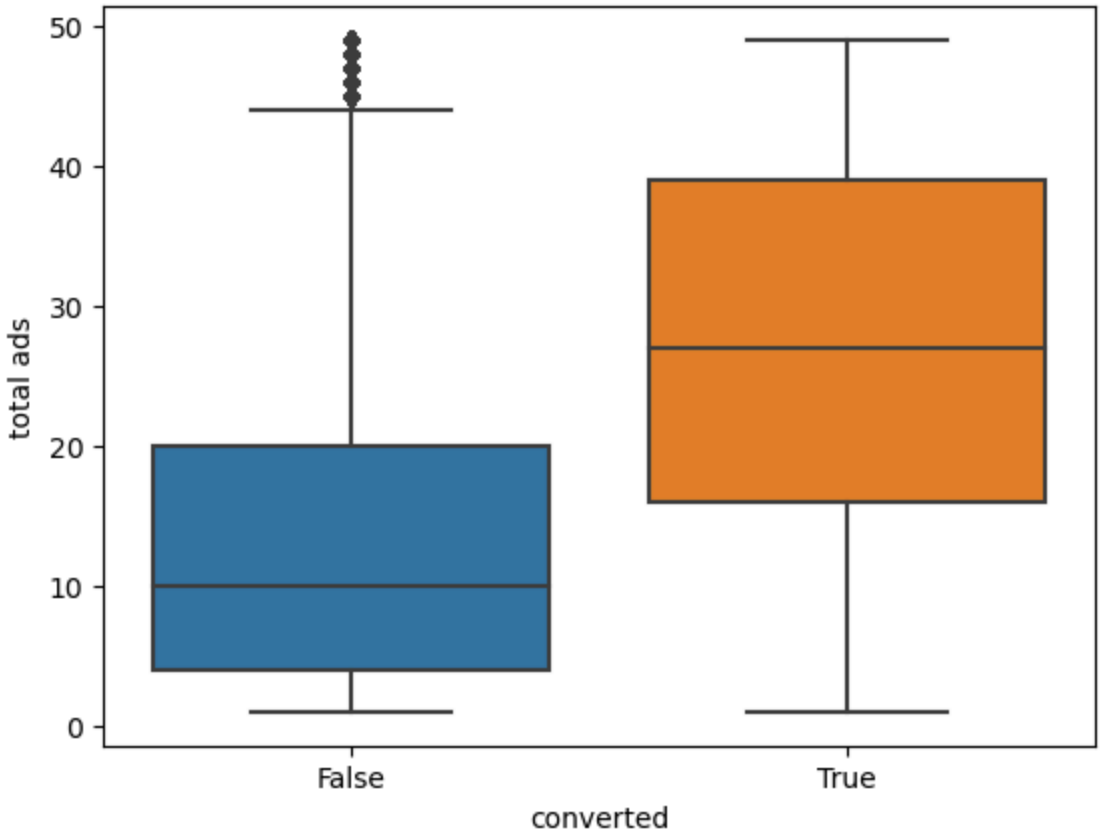
```
converted         False     True
most ads hour
16              0.969228  0.030772
20              0.970197  0.029803
15              0.970347  0.029653
21              0.971077  0.028923
17              0.971790  0.028210
14              0.971937  0.028063
18              0.972620  0.027380
19              0.973280  0.026720
22              0.973895  0.026105
13              0.975323  0.024677
12              0.976172  0.023828
23              0.977338  0.022662
6               0.977756  0.022244
11              0.977884  0.022116
10              0.978479  0.021521
5               0.979085  0.020915
8               0.980484  0.019516
9               0.980809  0.019191
0               0.981575  0.018425
7               0.981889  0.018111
4               0.984765  0.015235
1               0.987089  0.012911
3               0.989548  0.010452
2               0.992687  0.007313
```

Out[21]: <Axes: xlabel='most ads hour'>



In [22]:
```
sns.boxplot(x='converted',y='total ads',data=df[df['total ads'] < 50])
```

Out[22]: <Axes: xlabel='converted', ylabel='total ads'>



STATISTICAL ANALYSIS

(Performing for categorical)

Null Hypothesis H0 = There is no significant difference between conversion rates and other categorical variables(test_group, most ads hour, most ads day)

Alternative Hypothesis H1 = There is significant difference between conversion rates and other categorical variables(test_group, most ads hour, most ads day)

In [23]:
```
from scipy.stats import chi2_contingency
alpha = 0.05
for var in df_cat.columns:
    if var!='converted':
        cont_table = pd.crosstab(df_cat[var], df_cat['converted'])
        chi2, p, _, _ =chi2_contingency(cont_table)

        print(f"\nChi-Squared Test for {var} vs. Converted:")
        print(f"chi Squared Value: {chi2}")
        print(f"p-value: {p}")
```

```
Chi-Squared Test for test group vs. Converted:
chi Squared Value: 54.005823883685245
p-value: 1.9989623063390075e-13

Chi-Squared Test for most ads day vs. Converted:
chi Squared Value: 410.0478857936585
p-value: 1.932184379244731e-85

Chi-Squared Test for most ads hour vs. Converted:
chi Squared Value: 430.76869230822086
p-value: 8.027629823696771e-77
```

As we can see all the p-values for the three categories is less than alpha(0.05). We can reject the null hypothesis

Null Hypothesis H0: There is no significant difference in total ads between the two groups.
Alternative Hypothesis H1: There is significant difference in total ads between the two groups.

In [24]:
```
from scipy.stats import shapiro, levene, ttest_ind, mannwhitneyu

#checking for normality

shapiro_stat_true, shapiro_pvalue_true = shapiro([df[df['converted']== True] ['total a
shapiro_stat_false, shapiro_pvalue_false = shapiro([df[df['converted']== False] ['tota

print(f"Shapiro-Wilk test for normality(True Group): p-value = {shapiro_pvalue_true}")
print(f"Shapiro-Wilk test for normality(False Group): p-value = {shapiro_pvalue_false}
alpha

#checking for equality of variances
levene_stat, levene_pvalue = levene(df[df['converted']]['total ads'], df[~df['converte
print(f"Levene's test for variances: p-value = {levene_pvalue}")
```

```
C:\Users\kavya\anaconda3\Lib\site-packages\scipy\stats\_morestats.py:1816: UserWarnin
g: p-value may not be accurate for N > 5000.
  warnings.warn("p-value may not be accurate for N > 5000.")
Shapiro-Wilk test for normality(True Group): p-value = 0.0
Shapiro-Wilk test for normality(False Group): p-value = 0.0
Levene's test for variances: p-value = 0.0
```

In [26]:
```
alpha = 0.05

if shapiro_pvalue_true>alpha and shapiro_pvalue_false>alpha and levene_pvalue>alpha:
    t_stat,t_p_value = ttest_ind(df[df['converted']]['total ads'], df[~df['converted']
    print(f'Independent ttest pvalue = {t_p_value} ')

else:
    u_stat,u_pvalue = mannwhitneyu(df[df['converted']]['total ads'], df[~df['converted
    print(f'Mann Whitney U-test p-value = {u_pvalue}')
```

```
Mann Whitney U-test p-value = 0.0
```

since the p-value(0.0)<0.05 we reject the null hypothesis and conclude that there is a significant difference in total ads between the converted and non-converted groups.